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The Journal of the International College of Surgeons

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Vol. XXII NOVEMBER, 1954 No. 5

Original Articles

Clinical and Experimental Studies in the Treatment of Coronary Artery Insufficiency by Internal Mammary Artery Implant

ARTHUR VINEBERG, M.D., F.A.C.S.

MONTREAL, QUEBEC, CANADA

CLINICIANS have been aware of the disease angina pectoris for many years, and regularly have reported new medical measures that have been hailed as curative. Such treatments have swept the country in waves of enthusiastic optimism, only to be discarded in the light of cold facts. Likewise, in the past fifty years various surgical procedures, too numerous to mention, have been designed for the relief of angina pectoris. These, too, have been enthusiastically received and, depending upon the force and personality of the surgeon, have gained a certain popularity, only to be abandoned later. The surgical treatment of angina pectoris is not alone in this respect. One has only to recall the overwhelming clinical evidence presented in favour of lumbodorsal sympathectomy for the treatment of essential hypertension to be warned against the danger of a purely clinical approach to the problem of myocardial revascularization.

In my opinion, the value of any new surgical procedure must be firmly established in the laboratory before it is used in the treatment of human disease. There has been, and still is, too much experimen-

From the Departments of Experimental Surgery, McGill University and of Surgery, Royal Victoria Hospital, Montreal.

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tation on the animal Homo SAP-iens!

I should like to present a method of revascularization of the ventricular myocardium which has been developed and tested in the experimental surgical laboratories of McGill University during the past eight years, namely, the internal mammary artery implant.

Arterialization of the Intramural Vessels of the Left Ventricular Muscle by Means of Internal Mammary Artery Implantation.—Before proceeding to the details of this method for the revascularization of the ventricular muscle, a short review of the histological, anatomical and pathological structure of the myocardium must be given. There are two factors, now generally accepted, upon which the procedure of an internal mammary artery implant is based: one is the anatomic pattern of the myocardial circulation; the other is the modern concept of the pathologic character of sclerosis of the coronary artery.

1. *Anatomic Structure of the Ventricular Myocardium:* It is well known that there are many differences between cardiac and skeletal muscles. The differences most pertinent here concern the peculiarly rich network of blood vessels that supplies the myocardial muscle fibers. Actually, there exists within the myocardium a veritable spongework of vessels. Their arrangement is graphically shown in Figure 1.[1] As the smaller branches of the coronary arteries subdivide, they leave the surface of the heart and penetrate the myocardium at right angles. As they approach the endocardial surface they resume their horizontal direction and arborize into a rich arteriolar bed, from which the capillaries arise. The arterioles also communicate directly with sinusoid arterial spaces, which connect with the myocardial sinusoids. These latter vessels, with lumens of 50 to 250 microns in diameter, run a wandering course about the muscle fibers and anastomose with each other and the capillaries. Because of the structure of the myocardium, an implanted internal mammary

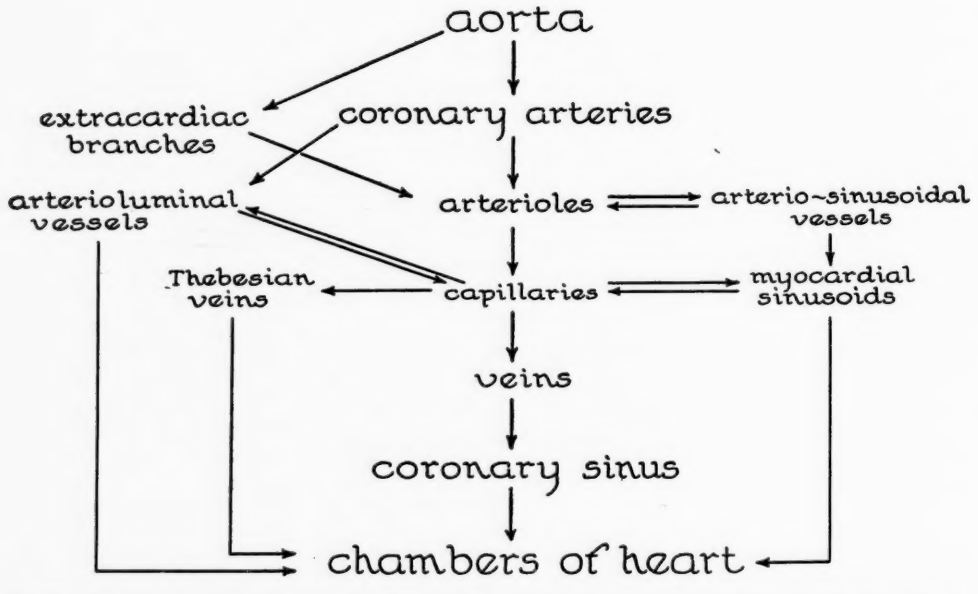

Fig. 1.—Graphic representation of relation between various components of the coronary circulation.

artery, with an open attached intercostal vessel, fails to form a surrounding hematoma and remains patent for an indefinite period.

The second factor indicating that the internal mammary artery implant will be a successful method of treating coronary artery insufficiency is based on the pathologic character and distribution of disease of the coronary artery.

2. *Pathologic Picture:* The generally accepted idea that disease of the coronary artery is widely spread throughout the coronary tree has not been borne out by pathologic study. Arteriosclerosis of the coronary arteries is usually, if not always, confined to the epicardial part of their courses and never involves the penetrating myocardial branches to any significant degree. Thus, in the presence of sclerosis of the coronary artery there is a vast network of arterioles, etc., deep within the myocardium, which are free of disease.[2] If arterial blood is delivered to this network, it can reach all parts of the ventricular myocardium. An implanted internal mammary artery thus can bridge over the blocked superficial coronary vessels, so that arterial blood can reach the intact deep arteriolar system of vessels still open and free of disease.

In the evolution of sclerosis of the human coronary artery a similar process occurs. It has been shown by Zoll[3] that in the normal human heart intercoronary anastomoses are rare. In the presence of arterial occlusion, however, intercoronary anastomoses develop distal to the point or points of occlusion. Such intercoronary anastomoses occur frequently and probably prevent myocardial infarction when the occlusion develops slowly. Zoll reported a study on a human heart with occlusion of the left anterior descending, left circumflex, and right coronary vessels of such extent that the major portion of blood supplied to the heart came from a large separate conus artery, which was connected with small branches below the points of occlusion in the descending coronary artery. It is thus not surprising that an implanted internal mammary artery,

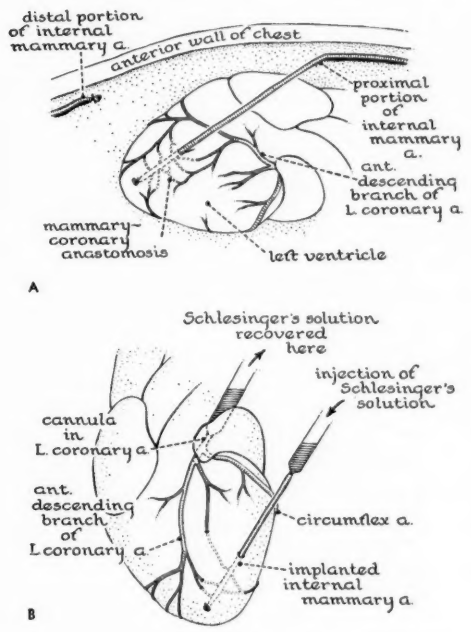

Fig. 2.—*A*, drawing of the internal mammary artery detached from its chest wall attachment and buried in a tunnel in the left ventricular myocardium. *B*, sketch showing how Schlesinger's injection mass is introduced through a cannula placed in the internal mammary artery weeks to months after implantation. In the presence of mammary-coronary anastomosis, the injection mass spreads throughout the left coronary arterial network and emerges from a second cannual placed in the mouth of the left coronary artery.

placed beyond the point of occlusion of the coronary artery and among the deep myocardial vessels, is capable of vascularizing the left ventricular muscle.

Procedure.—The left internal mammary artery is freed from the chest wall from the fourth to the sixth intercostal space. The distal end is doubly ligated and transected between the ligatures. A tunnel is made in the anterior wall of the left ventricle, and the freed portion of the artery is pulled into the tunnel and there fixed. The intercostal vessels that arise from the freed portion of the internal mammary artery are ligated, except for the sixth, which is transected just before the im-

plant is pulled into the myocardial tunnel. The internal mammary artery is thus placed in a tunnel within the ventricular myocardium, with an open, freely bleeding intercostal branch (Fig. 2*A*).

In previous publications[4] it was shown that an anastomosis developed between the implanted internal mammary artery and the left coronary circulation. The presence of such a mammary-coronary anastomosis was proved in the following manner:

Weeks or months after implantation the animals were killed. Two separate cannulas were used. One was inserted into the internal mammary artery, facing toward the heart; the other was tied in the mouth of the left coronary artery. The heart and the attached internal mammary artery were removed from the thoracic cavity, and Schlesinger's injection mass was introduced through the internal mammary artery. This injection mass is known to pass freely through no vessel smaller than an arteriole 40 microns in diameter. Where there was a large anastomosis the injection mass was seen to enter the internal mammary artery, spread throughout the coronary arteries of the left ventricle, and fill the cannula placed in the mouth of the left coronary artery (Fig. 2*B*). This would indicate that the anastomosis is formed with the arterial rather than the venous side of the coronary circulation. Afterward, injection roentgenograms were taken to show the distribution of the injection mass throughout the coronary circulation.

The roentgen studies having been completed, sections were taken through the area of implantation and serial section studies were made. These serial sections showed branches leaving the implanted internal mammary artery, and these branches could be followed out into the myocardium. In Figures 3 and 4 a serial section is shown which was taken through the site of internal mammary artery implantation forty-eight days after the implantation. Note how the injection mass in the lumen of the implanted internal mammary artery can be followed out through a new branch into the myocardium.

Having proved the presence of mammary-coronary anastomosis by injection roentgenographic studies and serial section, I decided to attempt visualization of the anastomosis by means of plastic casts.

From a few days to many months after implantation, a plastic solution was injected into the proximal end of the internal mammary artery. At the same time similar plastic solutions of different colors were introduced into the left coronary artery and the coronary veins. The injection mass did not enter the capillary vessels. Acid and alkaline solutions were used for digestion, and the resulting casts were studied under the dissecting microscope.

Two types of implants were studied: one in which the internal mammary artery was buried within the myocardium with its end open, and the other with its end closed but with an attached open bleeding intercostal branch. When the internal mammary artery was buried with its end open and bleeding into a myocardial tunnel, an anastomosis occurred between it and the left coronary arterioles within five days. The entire left coronary arteriolar system could be filled with plastic substance through this implanted artery (Fig. 5*A*, *B*). The presence of such anastomoses has been observed at least two and one-half months after implantation (Fig. 5*C*). When the internal mammary artery is buried with its end closed, but with an open sixth intercostal artery i.e., the standard implant described frequently during the past eight years, the artery can be seen to branch at the end of twelve days (Fig. 5*D*). These branches grow and, at the end of three to four weeks, are well formed arterioles that join up with arterioles lying in the left ventricular myocardium (Fig. 5*E*). The anastomoses between the new branches from the internal mammary artery and the arterioles of the left coronary artery are, however, not usually fully developed until a period ranging from six weeks to two months has elapsed.

In some of my injected specimens the

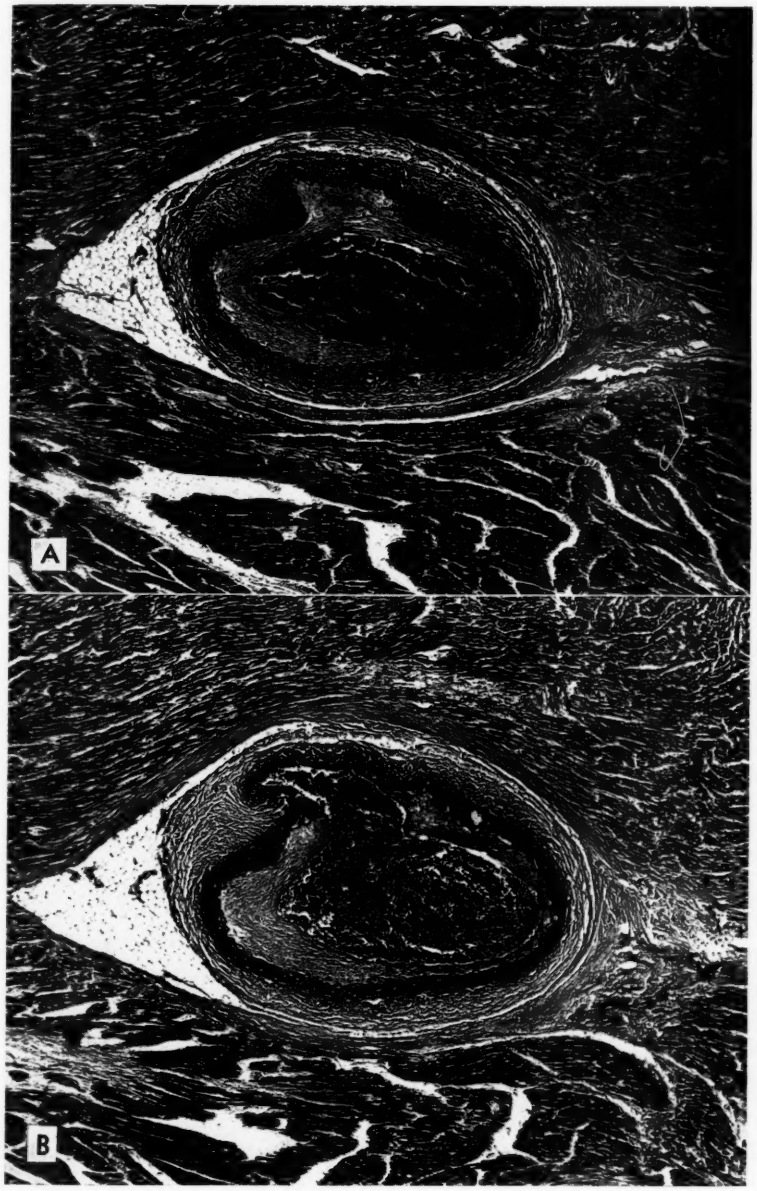

Fig. 3.—Serial section through site of internal mammary artery implant in experimental animal forty-eight days after implantation. *A*, serial section No. 13. Branching transplant with injection mass in lumen. *B*, photomicrograph of serial section No. 11 (elastic stain).

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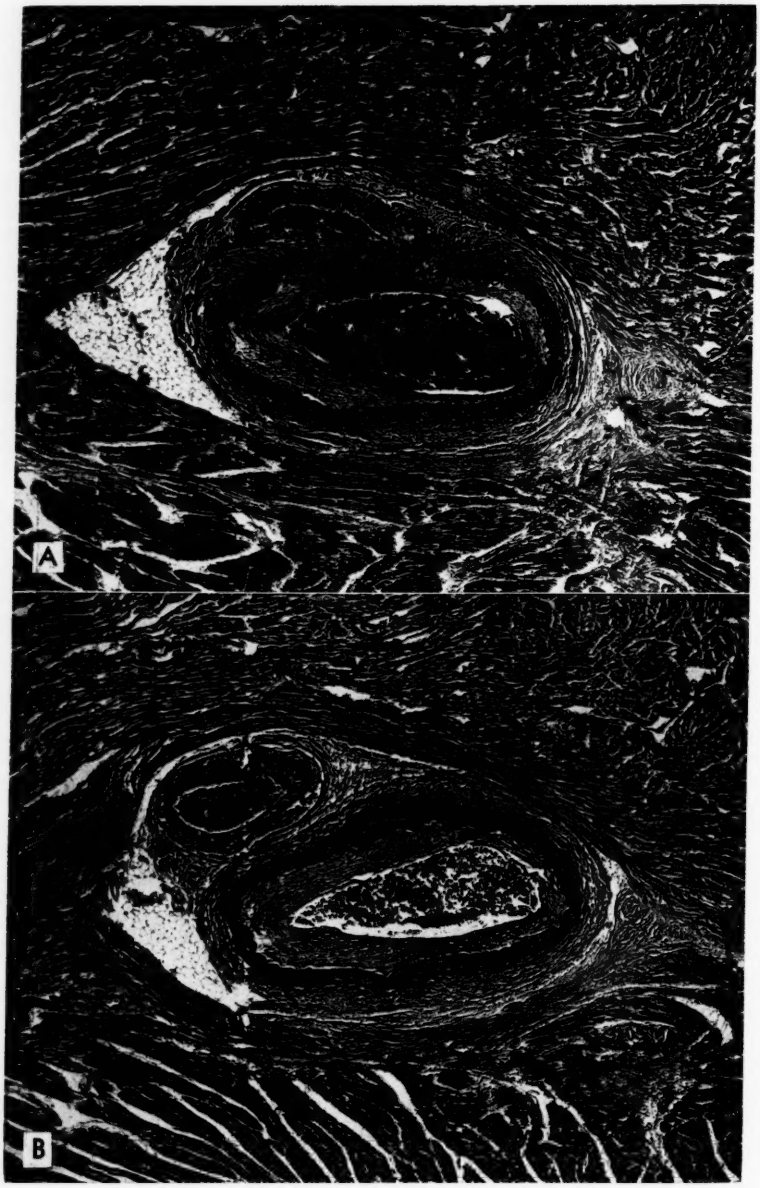

Fig. 4.—Serial section through site of internal mammary implant in same experimental animal represented in Figure 3, forty-eight days after implantation. *A*, photomicrograph of serial section No. 10; branching transplant mass in lumen. *B*, photomicrograph of serial section No. 8; branching transplant. (Elastic stain.)

casts show that the new branches join not only with the coronary arterioles but occasionally with the coronary veins (Fig. 5*C*).

Duration of Coronary-Mammary Anastomosis.—Glenn[5] and his associates have confirmed the development of an anastomosis between an implanted internal mammary artery and the coronary vessels. They stated, however, that the new vessels tend to disappear at the end of eight weeks. They further suggested that the new vessels were small and resembled granulation tissue.

In our series, the average interval from implant to the killing of the animal was eleven weeks (Table 1). One animal was kept for fifty-eight weeks after the implantation. The anastomoses at the end of that time not only persisted but were large enough to protect the animal against death and infarction after ligation of the anterior descending branch.

Character of Coronary-Mammary Anastomosis.—Not only has it been suggested that a coronary-mammary anastomosis tends to disappear at the end of eight weeks, but it has also been suggested that the nature of the anastomosis is capillary. Serial section studies of 7 implants have been examined. Special stains of these serial sections have been made to show elastic and muscle tissue. The character of the new branches formed by the internal mammary artery implant have thus been studied. They have proved to be arterial, containing both muscle and elastic tissue in their walls. These new arterial branches have been followed by serial section far out into the myocardium until they disappeared.[6]

Value of Coronary-Mammary Anastomosis.—Anatomohistologic proof of anastomotic channels between extracardiac arterial sources and the coronary circulation gives no indication of its functional value. This is true not only of coronary-mammary anastomosis but of all other procedures used for augmenting myocardial circulation.

Functional tests give the best indication of the value of the new arterial blood supply. These may be divided into three groups:

1. Survival experiments after ligation of the anterior descending branch of the left coronary artery.
2. Determination of the direction of blood flow in the internal mammary artery.
3. Experimental production of myocardial ischemia and its treatment by internal mammary implantation.

1. *Survival Experiments After Ligation of the Anterior Descending Branch of the Left Coronary Artery:* There is some divergence of opinion in the literature as to the effects of ligation of the anterior descending branch of the left coronary artery. There are those who claim a low mortality rate for this procedure, and others who claim a high one. The majority of investigators have found the mortality rate in dogs to range from 70 to 80 per cent. In my series of 10 control dogs the average mortality rate from ligation of the anterior descending branch was 80 per cent. It is my opinion that the great variation in mortality reported in the literature as following anterior descending branch ligation is dependent upon the site of ligation.

Method of Ligation: The anterior descending branch of the left coronary artery should be ligated at its point of origin. The position of the ligature must be carefully checked by examining the left coronary artery to make certain that the ligature has included all branches, other than the circumflex. Frequently one or two septal branches are missed, and occasionally branches arise from the main trunk of the left coronary artery.

An analysis of the results of ligation of the anterior descending branch is shown in Table 2. A total of 78 dogs were so treated. There were 10 controls and 39 other animals in which the coronary circulation was not augmented. In this group of animals there was an overall mortality rate of 80 per cent, with a survival rate of 20 per cent with infarction. In 29 animals, in which a large mammary coronary anastomosis had developed, there

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were no deaths and no infarctions after anterior descending branch ligation. Thus it would seem that coronary-mammary anastomosis not only increases coronary circulation but gives protection against death and infarction.

The experimental data shown in Table 2 indicate that coronary-mammary anastomosis, when it occurs, is of value in protecting against death or infarction. However, because of the differences of opinion concerning the value of survival after ligation of the descending branch, a second group of functional experiments was performed.

2. *Direction of Blood Flow in Implanted Internal Mammary Artery.* The direction of blood flow through the implanted internal mammary artery was studied in order to determine whether it was bringing blood to the ventricular myocardium. Direct determination of the direction of blood flow in the internal mammary artery was difficult, so the indirect method was used. Animals that survived ligation of the anterior descending branch of the left coronary artery were subjected, four to five weeks later, to complete and sudden occlusion of the implanted internal mammary artery. If the internal mammary artery was maintaining the circulation of the left ventricle, then, after the ligation, either death or infarction should result. This is exactly what happened. In 3 animals with an internal mammary artery implant which had survived ligation of the anterior descending branch, the internal mammary artery was ligated. One animal died within twenty-four hours and displayed an edematous, cyanotic area of the anterior wall of the left ventricle. One survived for three days before dying from a large infarct in the same location (Fig. 6). The third survived, but examination of the specimens from animals that had been killed revealed that multiple intercoronary anastomoses were present.

In all of these animals there was a demonstrable mammary-coronary anastomosis.

There can be little doubt that in those animals which died after ligation of the internal mammary artery, the circulation of the anterior portion of the left ventricle was being maintained by the internal mammary artery implant.

The evidence just presented suggested that the internal mammary artery, after implantation into the left ventricular wall, is capable of maintaining the left ventricular circulation. These experiments, however, were carried out on the hearts of normal animals. It was therefore necessary to attempt the artificial production of insufficiency of the coronary artery and to treat it by internal mammary artery implantation.

Thus, I set out to produce and treat experimental insufficiency of the coronary artery, and so establish a third functional test of the value of an internal mammary-coronary anastomosis.

3. *Experimental Production and Treatment of Coronary Artery Insufficiency:* In this series of experiments, insufficiency of the coronary artery was produced in dogs and treated by internal mammary artery implant. The first problem was to find a method of producing coronary artery occlusion that would simulate the type of occlusion that occurs with coronary sclerosis in man.

The second problem concerned the evaluation of coronary insufficiency when it was produced, and its response to treatment.

Method of Producing Insufficiency of the Coronary Artery: The anterior descending branch of the left coronary artery was exposed at its origin. Beneath the left auriculoventricular sulcus to the left of the pulmonary trunk, the epicardium overlying the vessel was incised and the bifurcation of the main coronary artery exposed. A doubly folded strip of cellophane (Dupont, P.T. 300), sterilized for twenty-four hours in a saturated solution of mercury oxycyanide, was twice wrapped completely, but loosely, around the origin of the anterior descending branch of the left coronary artery and fixed in position. Thus a segment of artery from 4 to 8 mm. long was completely surrounded with cellophane.

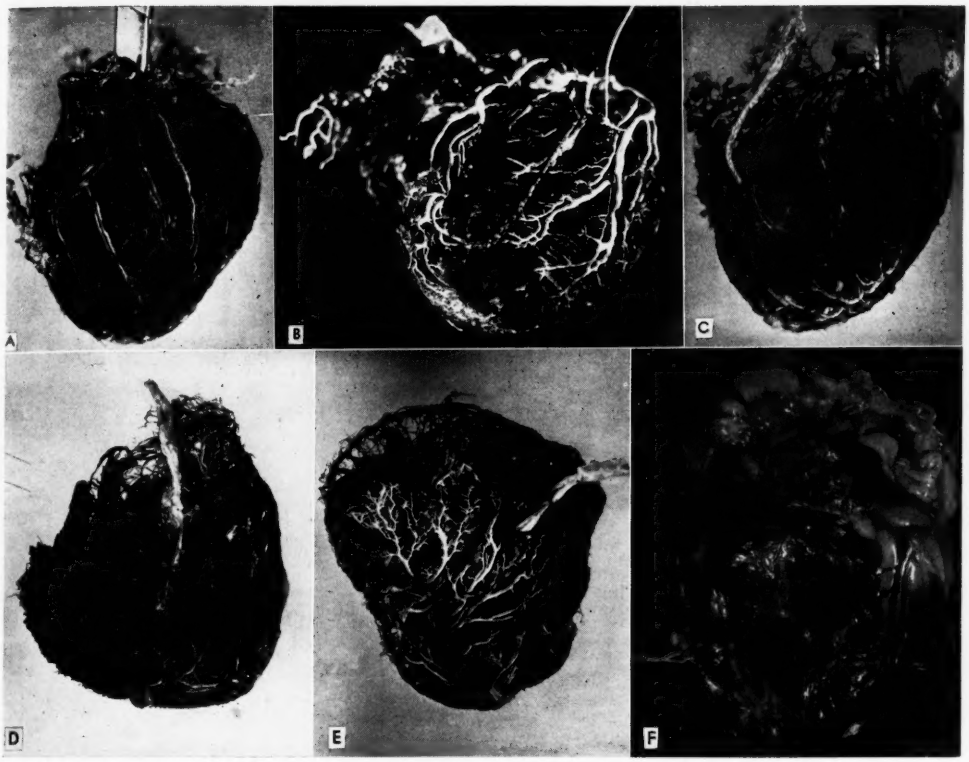

Fig. 5.—*A*, Dog 1. Internal mammary artery freed from subclavian to sixth intercostal artery and open end implanted in 2-inch (5 cm.) tunnel in left ventricular myocardium. Killed five days later in fight. Cannulas placed in internal mammary artery (shown by string) and in mouth of left coronary artery. Vinylite plastic injected and seen to fill vessels of left ventricle and emerge from left coronary artery. *B*, same cast as is *A*, except that the coronary vessels superficial to the implanted internal mammary artery were removed to show the underlying internal mammary artery. *Note* how in five days vessels leave the implanted internal mammary artery to join the left coronary arteries. *C*, Dog 2. Internal mammary artery freed from chest wall from sixth intercostal artery to subclavian and open distal end buried in 2-inch (5 cm.) tunnel in myocardium of left ventricle. Partial ligation of origin anterior descending done simultaneously. Seventy-seven days after operation the chest was opened and the subclavian artery isolated and injected with solution of india ink. The ink was seen to flow down the internal mammary artery into the heart, where it was seen in the coronary vessels. Cast was made by injecting internal mammary artery with yellow, coronary sinus with blue, and left coronary artery with red plastic solutions. *Note vast mammary-coronary artery anastomosis, also mammary venous anastomosis. D*, Dog 3. Internal mammary artery freed from chest wall between fourth and sixth intercostals and placed in tunnel 1 inch (2.5 cm.) long in ventricular myocardium, with open sixth intercostal. This animal died of pneumonia twelve days later. Cast made by injecting internal mammary artery with yellow, left coronary artery with red and coronary sinus with blue. Cast cut away to show buried internal mammary artery. Note tufting and branching from open sixth intercostal, attached to internal mammary artery. *E*, Dog 4. Internal mammary artery freed from fourth to sixth intercostal and implanted in 1 inch (2.5 cm.) tunnel in left ventricular wall with attached open sixth intercostal. Piece of sclerosing cellophane simultaneously wrapped around origin of anterior descending branch. Animal killed twenty-three days later because of distemper. Internal mammary artery was injected with yellow, left coronary with red, and coronary veins with blue plastic. *Note* brown color where yellow and red meet in mammary coronary anastomoses. *F*, heart of Dog. This animal withstood anterior descending branch ligation for sixty-seven days after internal mammary artery implant. Thirty-nine days later the thorax was reopened. The implanted mammary artery was ligated. This resulted in ectopic beats and cardiac irritability. The animal died three days after the operation. A large 3 by 3 cm. anterior wall left ventricular infarct was present. Perfusion of the internal mammary artery showed free communication between the implant and and the left coronary arterial tree, but not between the implant and the right.

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The cellophane initiated a fibroplastic reaction, with collagen deposition about the artery. As subsequent contracture of the new fibrous tissue occurred, the lumen of the anterior descending branch of the left coronary artery was slowly narrowed. Gradually that portion of the myocardium nourished by this vessel became ischemic.

At the end of the experiment, when the animals were killed, the anterior descending branch of the left coronary artery was probed to determine the extent of the narrowing. Sections were made through the artery at the site of the cellophane wrap, and careful histologic studies were made of the degree of coronary occlusion.

Method of Evaluation of Experimentally Produced Coronary Insufficiency and Its Treatment: Exercise tolerance test. In the presence of human coronary arterial insufficiency there are two outstanding symptoms, namely, substernal pain and intolerance to exercise.

In the dog, it is most difficult to detect the presence of pain. It is, however, not difficult to determine accurately the animal's tolerance or intolerance to exercise.

Clinical and pathologic experience have associated progressive intolerance to exercise with progressive myocardial ischemia. Thus, in the experimental animal, progressive diminution of such tolerance has been accepted as evidence of myocardial ischemia. In this series of experiments, myocardial ischemia was produced by a cellophane wrap placed around the point of origin of the anterior descending branch of the left coronary artery. Exercise tolerance studies were carried out before and after the cellophane wrap was applied. Later, after the internal mammary artery implant, they were repeated to determine whether improvement had occurred.

A treadmill was used to exercise the animals. This was made originally for man and was thus very satisfactory for exercising large animals. The exercise tolerance of each animal was established prior to wrapping the anterior descending branch with the sclerosing type of cellophane. Two groups of animals were studied. The first group was composed of those animals in which insufficiency of the coronary artery was produced by cellophane occlusion of the anterior descending branch and treated by internal mammary artery implant. In this series the average running time was reduced from nine to twelve minutes to two and a half to four minutes, at 8½ miles per hour, three months after the cellophane wrap. These animals were given an internal mammary artery implant, and, three to five months later, the running time had returned to six to eight minutes respectively, whereas the control animals had an average running time of one and six-tenths minutes at 8½ miles per hour. In those animals with an implant in whom the running time had returned, there was a wide open coronary-mammary anastomosis.

In the second group of animals, an internal mammary artery implant was performed at the same time the cellophane was wrapped around the anterior descending branch. Where there was a widely patent mammary-coronary anastomosis there was no appreciable reduction in exercise tolerance.

Treatment of Human Coronary Artery Insufficiency by Internal Mammary Artery Implantation.—On the basis of the foregoing anatomic, functional and pathologic facts, the internal mammary artery implant procedure has been used in the treatment of insufficiency of the coronary artery in man.

Selection of patients: The selection of patients for a new procedure is always difficult. I dislike classifications, however, and in a general way I have found it convenient to divide the cases into four groups:

Group I—Mild or intermittent angina. In this group are those patients who have an occasional attack of anginal pain on exercise or during an emotional disturbance. They are able to work and are capable of living lives reasonably close to normal. For this type of patient operation is not advisable: it is better for him to stop playing golf!

Group II—Progressive coronary artery

Fig. 6.—Section through human heart at site of internal mammary artery implant sixty-two hours later. *Note* how the vessel lies open between the myocardial fibers, and the absence of surrounding hematoma. This is remarkable, because the artery was pulled into position with an attached open bleeding intercostal vessel. The absence of clot in the lumen of the vessel is likewise to be noted.

insufficiency without disability. Evidence of progressive insufficiency of the coronary artery is an important indication for surgical intervention. Patients in this group may still be working, but there is evidence of progression of their disease. This may be shown in the electrocardiogram or by an increase in the frequency of anginal attacks and, perhaps, progressive dyspnea.

Group III—Partial or total disability, but without angina at rest. In this group are hundreds of thousands of persons, men and women, who are unable to walk more than 50 to 100 feet, or to do 22 steps on the Master two-step test, without anginal pain. Many suffer pain at rest, but in association with emotion, straining at stool or a heavy meal. Some have night pain, which awakens them. However, when sitting quietly in a chair, without stimuli, they are free from pain. Such patients have been accepted for operation; in fact, operation should be encouraged, as it has been shown that fewer than 50 per cent of such patients are alive at the end of five years. Another coronary artery occlusion may so lower their myocardial reserve as to place them in the hopeless, inoperable group of patients with status angina.

Group IV—Status anginosus. In this group are patients who have angina when

at rest. They literally chew nitroglycerin tablets day and night. One of my patients in this group consumed 180 nitroglycerin tablets in two weeks. This type of patient should not be submitted to a cardiac surgical procedure. There is insufficient cardiac muscle left to revascularize. Generally, the patient is living on a pinpoint opening in the one artery that is still open. Such a small opening usually cannot supply sufficient blood to the myocardium to keep the patient alive during and after a major thoracic procedure. In addition, such a patient generally has very little myocardial muscle left to revascularize.

Preoperative Investigation: With each patient I have attempted to exclude all other possible causes of his symptoms. This has been done in spite of a well-established diagnosis of coronary artery insufficiency. A search is made for intervertebral discs and for infradiaphragmatic and supradiaphragmatic lesions, and in all cases a psychiatric screening is done. A careful examination of serial electrocardiograms for evidence of recent activity must be made, as well as repeated observations of the sedimentation rate. In a few cases I have postponed operation for four to six months on evidence of activity obtained from the electrocardiogram and the sedimentation rate.

Contraindications: 1. *Evidence of left ventricular failure.* The history of left ventricular failure during an attack of myocardial infarction, with recovery, is not a contraindication. The presence of left ventricular failure, however, is most definitely a contraindication.

2. *Enlargement of the left ventricle,* unless it is due to hypertrophy associated with moderate hypertension.

3. *Advanced essential hypertension.*

4. *Evidence of recent myocardial infarction or of active disease.*

5. *Status angina.*

Present Series.—This report deals with my experience with 12 cases of coronary

TABLE 1.—*Duration of Anastomosis*

Type of Anastomosis	*No. of Animals*	*Presence of Anastomosis After Implant (weeks)*	*Value of Anastomosis After Ligation of Anterior Descending Branch of the Left Coronary Artery*
Microscopic	1	5	
	1	6	
	1	7	
Anastomosis small, owing to thickened or partially thrombosed internal mammary artery	2	8	Protection against death of infarction afforded in three animals only
	2	11	
	2	12	
	2	13	
	1	14	
	12		
Microscopic	1	6	
	2	7	
	5	9	No deaths or infarctions
	5	11	
Anastomosis large	4	12	
	2	14	
	1	17	
Internal mammary artery patent	1	18	In cellophane coronary artery sclerosis caused by cellophane irritation, marked improvement in exercise tolerance occurred
	3	19	
	1	21	
	1	31	
	1	41	
	1	46	
	1	58	
	29		

TABLE 2.—*Experimental Data*

	Ligation of Anterior Descending Branch of the Left Coronary Artery			
	No. of Dogs	*Death, %*	*Survival with Infarction, %*	*Survival without Infarction, %*
Control	10	80	20	0
Internal mammary artery implant and/or other experiments but without augmentation of the coronary circulation	39	80	3	17
Internal mammary artery implant with coronary anastomosis	29	—	—	100

Note: Internal mammary artery after implantation formed anastomoses with coronary circulation in from 50 to 75% of animals operated upon.

artery insufficiency in which the patients have undergone internal mammary artery implantation in the past three years. Some of the facts concerning each patient are shown in Table 3.

The patients have been divided into two groups—those without angina at rest, and those with status angina.

All of these patients were male. Their ages varied from 36 to 57 years—the majority were over 52. All were unable to work at the time of operation. Their periods of disability varied from seven to thirty-six months.

Of these 12 patients, 10 had had one or more proved myocardial infarction. Anginal pain was not the only symptom. In 7 of these, dyspnea on effort, and in 6 fatigue, were prominent symptoms. Exercise tolerance varied from 50 to 200 feet on the level and was markedly lowered in the two-step test. Occupations varied from that of physician to that of machinist-welder. It should be noted that practically all of these patients were desperate. They had reached a stage at which life was no longer livable. The majority of them fully expected to die from the operation—and did not care. Even after the mortality rate and the chances of failure had been explained to them, they elected to undergo surgical treatment. Two of the surviving 12 patients had had anterior and posterior ventricular infarctions. This is interesting in view of Bailey's statement that multiple infarction is a contraindication to surgical treatment. It must be stated, however, that all 3 of the patients who died had had two or more infarcts. These patients, however, had pain at rest; their exercise tolerance was zero.

In the selection of patients for operation, the condition of the ventricular myocardium to be revascularized is the crux of the situation. It is futile to attempt to revascularize scar tissue. Clinical estimation of the amount of myocardial muscle remaining to revascularize is most important. In my opinion, exercise tolerance studies combined with fluoroscopic and electrocardiographic studies help to estimate the myocardial reserve.

Results.—The results of operation are shown in Table 4. In 12 patients the operation of internal mammary artery implant has been completed. Of these 12, 9 have survived. There have been no deaths among the patients who had no angina at rest. Even though 2 of these patients had had both anterior and posterior infarctions, there was still some myocardial muscle left to revascularize. Both have done well. In the group of 9 patients, all had been incapacitated before the operation; none were working. At the time of writing, 7 are working. Three have slight pain on severe exertion, and 1 has severe pain. Five are completely pain-free.

It should be noted that, in the case of my first surviving patient, it is now three years since the operation, and from a con-

dition of complete disability he can now walk 10 miles through the bush.

There has been 1 failure in the group: the patient still suffers pain as severe as before the operation. Examination of the heart under the fluoroscope reveals that the apex is tilted upward and laterally, and that this is accentuated during deep respiration. It would seem that the internal mammary artery was placed in the heart without sufficient slack to allow for the movement of respiration. This artery is probably firmly thrombosed.

Perhaps the most interesting case is that of S.E., a 57-year-old electrician with a large anterior wall infarct, who was totally incapacitated. He was operated upon in March 1952 and returned to his work in September, feeling extremely well. In May 1953, severe substernal pain developed, and he was hospitalized for what appeared to be an attack of myocardial infarction but turned out to be coronary artery occlusion without infarction. This man returned to work in July 1953 and is still working. The electrocardiagram reveals no change since the operation. It would seem that he underwent coronary artery occlusion without infarction. In a heart such as his, but without the internal mammary artery implant, if death had not occurred, at least infarction should have occurred after a third coronary artery occlusion.

Of the 3 patients in status angina, 2 died sixty and sixty-two hours, respectively, after the operation, and 1 died of cardiac arrest on the operating table. In these patients the two major arteries were observed at autopsy to be blocked, and they had been living on a pinpoint opening in a remaining vessel. In each instance

TABLE 3.—*No Angina at Rest; Anginal Pain*

Patient Name	*Sex*	*Age*	*Occupation*	*Time Disabled (Months)*	*At Rest*	*Amount of Exercise*	*Eating*	*Night*	*Dyspnea*	*Fatigue*	*Previous Infarction*
DM	M	54	Oil Field Worker	7	No	150 ft.	Yes	No	Yes	Yes	None
ES	M	49	Executive	24	No	100 ft.	Yes	No	Yes	No	Anterior; posterior
CA	M	55	Machinist	24	No	150 ft.	Yes	No	No	No	Large anterior
AM	M	55	Grocer	10	No	50 ft.	Yes	No	Yes	Yes	None
SE	M	57	Electrician	10	No	50 ft.	No	No	No	No	Large anterior
GA	M	52	Farmer	28	No	200 ft.	No	No	Yes	Marked	Posterior
LGM	M	39	Physician	24	No	50 ft.	Yes	Yes	Yes	Marked	Anterior; posterior
MB	M	36	Railroad Switchman	18	No	75 ft.	Yes	Yes	Yes	Yes	Anterior; septal
CH	M	48	Engineer	17	No	50 ft.	Yes	Yes	Yes	Yes	Posterior
						Status Angina					
JP	M	53	Tailor	36	Yes	0	Yes	Yes	No	No	Anterior; posterior
FC	M	57	Civil Servant	36	Yes	100 ft.	Yes	Yes	Yes	No	Anterior; posterior
AC	M	46	Stevedore	12	Yes	150 ft.	Yes	Yes	Yes	No	Anterior; posterior

TABLE 4.—*Results*

Patient Name	*Time Since Operation (Months)*	*Occupation*	*Anginal Pain*	*Exercise Before*	*Tolerance After*	*Ability to Work, Hours Per Day Before*	*After*
D.M.	34	Oil Feild Worker	None	150 ft.	Up to 10 miles	No	8
E.S.	34	Executive	Yes	100 ft.	Dances, etc.	No	No
C.A.	33	Machinist	After severe exercise only	150 ft.	½ mile	No	16
A.M.	27	Grocer	Slight, on severe exercise only	50 ft.	¼ to ½ mile	No	Part time
S.E.*	18	Electrician	Occasional	50 ft.	½ mile	No	8
G.A.	9	Farmer	None	200 ft.	Not known	No	Working
L.G.M.	7	Physician	None	50 ft.	1 mile	No	Postgraduate course
M.B.	2	Railroad Switchman	None	75 ft.	Not tested; improved	No	Convalescent
C.H.	3	Engineer	None	50 ft.	1 mile	No	Working

Status Angina

3 cases, all patients died within sixty-two hours of operation.

*S.E. Internal mammary artery implant, March 1952. Returned to work September 1952. May 1953 had severe substernal pain: considered to be thrombosis without infarction. July 1953, returned to work. Has slight pain on exertion only. No change in electrocardiogram noted as following recent thrombosis.

there was very little muscle left to revascularize, and this was extremely thin. Figure 12 shows a section through the site of the internal mammary artery implant in the first of my patients who died. Note that the artery, sixty-two hours after implantation, is wide open, and that there is no surrounding hematoma.

SUMMARY

It has been shown experimentally (1) that the internal mammary artery, after implantation into the left ventricular myocardium, forms an anastomosis with the left coronary circulation; (2) that the implant is capable of sustaining life and preventing infarction when a major coronary vessel, the anterior descending branch, is occluded, and (3) that the implant is capable of revascularizing the myocardium in a high percentage of experimental cases.

Twelve human patients have been operated upon, with 3 deaths and 8 good results.

One patient has had coronary occlusion since the operation, without infarction. This patient has returned to work, and it appears that his mammary artery implant probably protected him from death and definitely protected him from infarction.

RÉSUMÉ

(Estudos clínicos e experimentais no tratamento da insuficiência da artéria coronária pelo implante da artéria mamária interna.)

Foi evidenciado experimentalmente (1) que a artéria mamária interna, após implantação no miocardio ventricular esquerdo, forma uma anastomose com a circulação coronária esquerda; (2) que o implante é capaz de sustentar a vida e impedir o enfarte quando um vaso coronário maior, a ramo descendente anterior, é ocluido, e (3) que o implante é capaz de revascularizar o miocárido numa porcentagem elevada de casos experimentais.

Doze pacientes humanos foram opera-

dos, com 3 mortes e 8 bons resultados.

Um paciente desde a operação possue oclusão coronária, sem enfarte. Este paciente voltou ao trabalho e, parece que seu implante da artéria mamária provàvelmente o protegeu da morte e definidamente do enfarte.

ZUSAMMENFASSUNG

Es ist experimentell nachgewiesen worden dass (1) die A. mammaria int. nach Einpflanzung in das Myokard der linken Herzkammer eine Anastomose mit der linken Kranzader bildet, (2) das Transplantat imstande ist, das Leben zu erhalten und einer Infarktbildung vorzubeugen, wenn eine grössere Kranzschlagader, nämlich der vordere absteigende Ast, verstopft ist und (3) ds Transplantat in einem hohen Prozentsatz der Versuchsfälle den Herzmuskel revaskularisieren kann.

Von zwölf operierten Kranken starben drei, während acht gute Resultate aufzuweisen hatten.

Einer der Patienten erlitt seit der Operation einen Kranzaderverschluss ohne Infarktbildung. Inzwischen ist der Kranke wieder zu seiner Arbeit zurückgekehert; offenbar hat die Einpflanzung der A. mammaria int. ihn vor dem Tode gerettet und sicherlich die Bildung eines Infarktes verhütet.

RESUMEN

Se ha demostrado experimentalmente: (1) que después de la inplantación de la arteria mamaria interna en el miocardio ventricular izquierdo se forma una anstomosis con la circulación coronaria izquierda; (2) que la inplantación es capaz de mantener la vida y prevenir el infarto cuando se ocluye un vaso coronario grande ó una rama descendente anteior, y (3) que la implantación es capaz de revascularizar el miocardio en alto porcentaje de casos experimentales.

Se han operado doce pacientes humanos con buenos resultados en 8 de ellos, y muertes en los 3 restantes.

Un paciente tuvo una oclusión coronaria después de la operación, sin presentarse infarto. Este paciente volvió al trabajo y parece ser que la inplantación de la mamaria interna lo protegió de la muerte y definitivamente del infarto.

RIASSUNTO

E' stato dimostrato sperimentalmente 1) che l'arteria mammaria interna impiantata nel ventricolo sinistro forma anastomosi col circolo coronarico di sinistra; 2) che tale impianto può mattenere in vita e prevenire l'infarto dopo legature della descendens antenior; 3) che può rivascolarizzare il miocardio in un gran numero di casi sperimentali. Sono stati operati 12 pazienti, con 3 morti e 8 risultati buoni. Uno di esse aveva un'occlusione coronarica senza infarto; riprese il lavoro dopo l'intervento, sicchè si può considerarlo guarito.

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Hematoma of the Rectus Abdominis Muscle

Report of a Case, Discussion of the Entity and Review of Illustrative Cases from the Literature

MAX THOREK, M.D.

CHICAGO, ILLINOIS

AND

LAURO B. DE VERA, M.D.

PHILIPPINE ISLANDS

A CASE of spontaneous hematoma in the rectus abdominis muscle or within its sheath invariably arouses a great deal of clinical interest, owing to the rarity of the condition and the diagnostic puzzles it often presents. Doubtless more cases occur than are recognized and reported, and those in which the diagnosis has been confirmed supply a considerable literature on the subject. In 1949, Aird stated that some 150 cases had been recorded, and a number have been published since then.

Many hematomas of the rectus abdominis are associated with definite etiologic factors; for example, those occurring during pregnancy or during epidemics of diphtheria. There remain, however, cases in which no obvious cause can be discovered. In these the individual cause must be based on speculation drawn from knowledge of comparable cases and a basic understanding of the mechanical character of the muscle as well as its vascularization.

Statistics on extensive series indicate that cases of this "idiopathic" type make up a major group—not improbably the largest. This is especially important from a diagnostic point of view, for a hematoma of the rectus abdominis may readily simulate any of a number of intra-abdominal lesions, thus leading to misdiagnosis. Indeed, an examination of the literature shows all too clearly that this is the rule, the correct diagnosis being confirmed in most instances only after intervention and examination of the abdomen. Only in a minority of cases has the preoperative diagnosis proved correct.

It is therefore essential, first, to become aware of the possibility of this condition in a given clinical picture, and second, to learn to recognize the minimal points in a case history that might direct attention to this possible diagnosis. With this object in view, the following personal case history is submitted.

REPORT OF CASE

The patient, a white woman aged 35, was admitted to the hospital on Nov. 29, 1952, with complaints of severe pain in the right lower abdominal quadrant, with tenderness and nausea. Apparently the illness had begun one week before admission as an intermittent smarting sensation in the right lower quadrant especially while the patient was at work. On the third day (the fifth before admission) the paroxysms became progressively heavier and longer, lasting for several seconds. Throughout the day prior to admission the pain grew sharper, coming at shorter intervals (about thirty minutes) and lasting about a minute. It came on suddenly, with a feel-

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ing of chilliness over the whole body. Urination was more frequent than usual, but the patient could urinate at the height of pain. On the morning of admission, while on the way to work, she felt a sudden, sharp, continuous, stabbing pain—not colicky and not throbbing—localized primarily in the right lower quadrant of the abdomen, with mild radiation to the right lumbar area. This excruciating pain was accompanied by cold sweats, as urge to urinate (without successful urination) and a fainting sensation. After an hour the patient could neither bend the abdomen nor flex the right thigh without aggravating the pain, and the area had become so tender that minor pressure evoked a loud cry. By about noon the patient sought the advice of her physician, who brought her at once to the hospital.

She was extremely nervous and complained of extreme pain, nausea, and constipation (no bowel movement had occurred since the start of the sharper paroxysmal pain on the day before admission). Urination was free. The pulse rate was 88, respiratory rate 20, the temperature 99 F. and the blood pressure in millimeters of mercury 150 systolic and 100 diastolic. The patient seemed more comfortable with the legs outstretched than in the crouching position.

Physical examination showed her to be fairly well developed, with no abnormalities of the head, neck, chest, lungs or heart. The abdomen showed no visible bulges or peristaltic waves. Its color was normal, even in the area of pain. Palpation revealed such marked tenderness in the right lower quadrant that rebound tenderness could not be elicited because of discomfort to the patient. In the same area a somewhat elongated, vertical and definitely bordered mass 3 by 5 inches (7.5 by 12.5 cm.) was palpable, but no throbbing or thrill was detected. Percussion produced normal resonance and no tympanism; on the tender area percussion was not tolerated. Auscultation revealed no borborygmi or any abnormal sounds such as increased peristaltic sounds indicating bowel obstruction. The skin in general was of normal color, without petechiae or ecchymosis on any part, including the area of abdominal tenderness. The reflexes were normal. Vaginal examination showed no leukorrhea or bloody discharge. The uterus was apparently anteverted. It was movable and not enlarged. The cervix was hard and closed; pushing it upward caused pain referable to the right adnexae. The right adnexae seemed full; the left adnexae, free and nontender. Abdominal and vaginal fingers could not be approximated without causing much pain and discomfort. A blood count on the day of admission showed 4,000,000 erythrocytes and 8,600 leukocytes per cubic millimeter, with 26 per cent lymphocytes and 1 per cent monocytes. The Kahn test gave a negative result. The urine was normal in all respects.

Previous History.—The menstrual history was normal. The social history and habits were irrelevant. There was no history of venereal disease. The patient had undergone cholecystectomy seven years earlier for cholecystitis and cholelithiasis; nine years earlier, appendectomy for acute appendicitis. She reported that *after a tooth extraction a year prior to admission bleeding was hardly controllable for five hours, requiring epinephrine, coagulants and gauze packing.* She also stated that, since childhood, *finger cuts had given rise to abnormally prolonged bleeding; that about a month prior to admission a small scratch on the dorsum of the right wrist bled for fifteen minutes or longer.* No spontaneous bleeding of the oral or rectal mucous membranes, however, was noticed except when she brushed her teeth. She said that in her work in a dress shop she occasionally bumped her hip and the right iliac region against the edge of a table, causing a mild contusion with hematoma lingering a couple of days. Such contusion or hematoma, she claimed, had not occurred for the past two months. There was no history of spontaneous petechiae, ecchymosis or other closed hemorrhages.

Roentgen Examination.—A scout film of the abdomen revealed an area of diffuse density occupying the small pelvis and the lower part of the abdomen, with no evidence of a distinct tumor mass, intestinal obstruction or urinary or biliary concretion. The roentgen observations suggested a soft tissue structure of undetermined origin occupying the small pelvis, possibly a tumor of the genital organs.

Course.—During the first five days the patient was under conservative treatment and observation. On admission she was directed to take nothing by mouth and was given intravenous dextrose with thiamine hydrochloride. Duracillin and Demerol-H were also administered, and an ice cap was applied to the lower part of the abdomen. On the next day she felt much better, but the tenderness was not controlled. Intravenous fluids were discontinued and she was given a liquid diet,

with sulfathalidine given by mouth every four hours. At the end of the fifth day, comparatively speaking, she was much improved, with the pain considerably diminished. The mass, however, was still palpable, undiminished in size and extremely tender.

The clinical diagnosis at this time was *right twisted ovarian cyst.*

Operation.—Operation was undertaken on the following day (the sixth). A median suprapubic incision was made, and the peritoneum was observed to be normal in color and consistency. The right rectus muscle, however, was swollen, pushing the subcutaneous tissue and skin upward from about 1½ inches (3.7 cm.) below the level of the navel to an area just above the pubic bone. The muscle was decidedly bluish and evidently hematomatous. It was opened, without involving the peritoneum, and an extensive hematoma was discovered in the muscle, extending down to the pyramidalis portion. The clotted blood was evacuated and the oozing cavity packed with gauze.

Immediately after the operation the patient was given routine postoperative care, with penicillin, Demerol and surgical liquids. A blood test four hours after the operation showed a coagulation time of three minutes, a bleeding time of four minutes and thirty seconds, and a platelet count of 468,000. Six days later the coagulation time was five minutes and thirty seconds and the bleeding time four minutes and thirty seconds. The gauze packing was pulled out fractionally during two days after the operation. On the first postoperative day the patient was practically free from pain, except the usual pain after surgical treatment, and was comfortable until her discharge, ten days after the operation. The postoperative course was uneventful.

COMMENT

Anatomic Background.—A discussion of this and similar cases may well begin with certain anatomic considerations. The anatomic picture has been described in an outstanding study by Brödel, which is the chief source of the following observations.

The rectus abdominis as a whole undergoes great extension and contraction, especially in extension and flexion of the trunk, and its morphologic character seem to facilitate this action. The muscle is divided into four or five separate masses by transverse tendinous intersections, an arrangement that permits maximum contraction with minimum bellying. Provision is thus made for the great exertion required in raising the body from the horizontal and for the strains of coughing and defecation. In addition, the muscle is under almost constant tension in regulating the intra-abdominal pressure and in expiration (Fig. 1).

Incidentally, in the dynamics of the muscle, the superior pubic ramus and the symphysis pubis are really the fixed points and should be considered the origin, though the symphysic end is traditionally described as the point of insertion. This point has a bearing on rupture and possible hematoma formation, for both conditions occur most frequently in the lowest muscle segment adjacent to the pubis, which is the narrowest and thickest part of the muscle (Fig. 2*A*).

The vascularization of the rectus muscle also appears to make provision for vigorous contraction and stretching. The vascular system is really twofold. The inferior epigastric artery rises from the external iliac artery and flows cephalad, while the superior epigastric artery rises from the internal mammary artery and flows caudad. The main vessels of these systems lie in a shallow groove on the dorsal surface of the rectus, entering the muscle at the midepigastric portion, where the systems join. The branches from the main vessels likewise lie on the dorsal surface for some distance, especially on the lower rectus, before entering the muscle. Thus they are spared undue stretching and torsion from the stretching and bellying involved in muscular activity. Provision for vascular freedom is especially important in the venous system, since the two veins accompanying each artery and arteriole are more fragile and thinwalled (Fig. 2*B*).

Muscular contraction is important to proper blood circulation; stasis and agglutination do occur, however, having been observed even in normal circulation, and may lead to minute thrombosis and hyaline degeneration of muscle fibers. Brödel suggested that the hyaline degeneration of muscle may follow stasis, agglutination, and minute thrombosis, especially in the venules. This may occur in the presence of mild infection or even in a state of health. If the degeneration is considerable, the unaffected part of the muscle may tear the weakened portion and its veins or, less easily, its arteries.

Another important anatomic feature is the tendinous rectus sheath encasing the muscle. The anterior leaf of the sheath covers the entire ventral aspect, adhering to the transverse tendinous inscriptions. Dorsally, however, the posterior leaf is not adherent to the muscle and ends with the linea semicircularis Douglasi, leaving the lower rectus muscle exposed, as well as those vessels of the inferior epigastric system which lie free on its ventral surface. In this area the muscle is separated from the viscera only by the thin peritoneum and is readily exposed to infection. A hematoma between the muscle and its posterior leaf, spreading downward to this exposed area, would thus press upon the peritoneum, causing symptoms of intra-abdominal disease (Fig. 3).

Teske, in reviewing the location of hematomas in 100 cases collected from the literature, has pointed out the further importance of the anatomic features. A hematoma in the lower third of the muscle not only can dissect laterally but can spread to the opposite side, as the recti are not here separated by dense fibrous tissue. A hematoma at a higher level could be expected to spread upward or downward, though it could extend below the linea semicircularis. Hematomas have been recorded as extending the entire length of a muscle, either right or left (Hobbs; Zohman). The right lower rectus seems to be the site in about half the cases (Teske; Wohlgemuth), with the left lower coming next in order, then the right upper and the left upper. Of 4 cases of bilateral hematoma reviewed by Teske, 3 may have involved crossing of the midline.

Etiologic Factors.—Of course, the muscular strength and the possible degeneration of muscle fibers vary widely among individual persons, so that one finds a wide variety of traumas sufficient to precipitate rupture of the muscle or its vessels. Sometimes this takes the form of a definite external trauma or a definitely recognizable strain. At other times the course of infectious disease has clearly laid the goundwork of muscular degeneration, so that minimal trauma is sufficient. Obesity, pregnancy, or childbearing may impose excess strain, so that a small trauma—frequently due to a severe coughing spell or to strain at defecation—will precipitate rupture and hemorrhage. In other cases no trauma is recognizable, and the hematoma is readily mistaken for an acute abdominal condition.

All these conditions have been reported in the literature. Perhaps the earliest case of rectus abdominis hematoma recorded in full was that reported by Richardson in 1857. An athletic young man aged 28, after hopping over a narrow ditch, immediately noticed an acute persistent pain about 2 inches (5 cm.) below and to the right of the umbilicus, followed by nausea and a constant desire to evacuate the bowels. It was said that he heard the sound of the muscle snapping immediately before he felt the pain. Two days later his condition had become worse, with sleeplessness, vomiting, nausea, headache and tenesmus. Operation revealed a large clot, weighing about ½ pound (226.8 Gm.), resting on the peritoneum and pressing on it and the viscera. The entire right

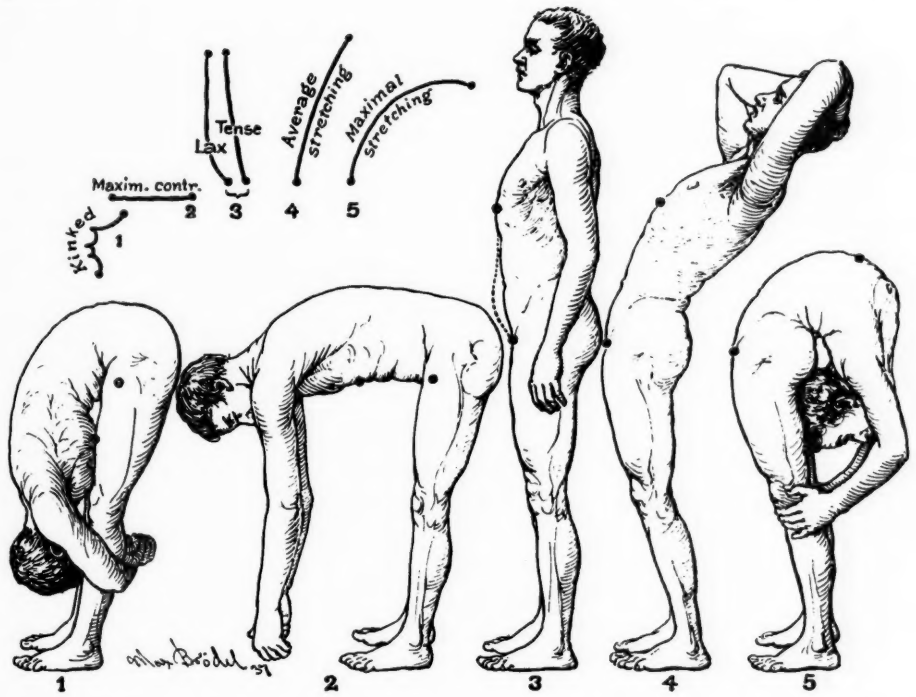

Fig. 1.—Rectus muscle in five positions of the body: *1*, maximally contracted and kinked (acrobat); *2*, maximally contracted and straight; *3*, erect, lax and tense; *4*, average stretching; *5*, maximally stretched (acrobat). *Reproduced by permission of the Johns Hopkins Press from Brodel, op. cit.*

rectus abdominis muscle and its sheath, vessels and nerves, together with the epigastric artery, had been torn across between the lineae transversae. The clot was cleared and one artery subjected to torsion. Recovery was satisfactory.

Richardson also referred to an earlier case that he had seen mentioned but not reported in detail. Earlier cases were also collected by Maydl (1882), who published a list of 14 occurring between 1809 and 1881.

Many of the traumatic hematomas have been observed in young men in the course of exercise or military training. These include both internal trauma, such as quick or excess strain, and external trauma, such a blows or bumps. World War II added a number in which this lesion occurred in military trainees; for those in the United States Services, see the series of Bowers and Richard and that of Fruin and McLaughlin.

Pregnancy is an important etiologic factor, according to Culbertson, who stated that most female patients are either pregnant or parous. In practically all cases in which the hematoma occurred during pregnancy the patients were said to be in the second half of the period of gestation.

The earliest report of spontaneous hematoma of the rectus in pregnancy is thought to be Stoeckel's 2 cases (1901). Each of the lesions was apparently precipitated by a coughing spell; in the second, that the midwife diagnosed twins, and the

patient was delivered of her child by normal labor fourteen days before entering the clinic to be treated for the remaining swelling. Operation revealed a hematoma in the right rectus sheath, with partial rupture of the muscle bundles. Vogt (1913) reported a case in which bilateral tumors were discovered after successful childbirth, apparently having developed during labor. Rest and application of ice-bags reduced the pain and somewhat diminished the swelling. The patient was discharged after twenty-one days, and four weeks later evidence of the condition had disappeared, without operation.

A third important type of hematoma is that associated with debilitating diseases. A study of this type suggests that some similar process may be at work in those cases in which a clear-cut disease entity is not evident. The remarks by Vilar on this situation deserve quotation:

"The cause of these spontaneous hematomas resides in a vascular and muscular alteration produced by general diseases, and the minimal trauma is simply the precipitating factor. They occur very frequently in the course of typhoid, generally in the course of the third week, in grippe, chickenpox, scarlatina, measles, gonorrhea, tuberculosis, etc., that is to say in all affections which increase the muscular-vascular friability. In fact, histological studies of the muscular fibers in the zone of the hematoma show waxy degeneration and fairly characteristic color alterations. Similar pictures are described in arterial diseases (like advanced arteriosclerosis), blood dyscrasias (as for example hemophilia or purpura thrombocitopenia), in leukemia and cirrhosis."

In addition, Cullen has mentioned the importance of influenza and influenzal pneumonia as predisposing diseases.

The pathologic manifestations of this type of degeneration have received considerable attention. Virchow (1857) described the appearance of the tumor in ruptured rectus muscles in cases of typhoid fever. Zenker (1863) described the condition as observed in autopsies on patients who had died of typhoid during an epidemic of that year, and the name "Zenker's degeneration" has been given to this type of hyaline degeneration of the muscle fibers. The degeneration is also associated with influenza, and the epidemic of 1918 brought on numerous cases, many in army camps, where it was evidently an etiologic factor in producing hematoma. The condition in American Army camps has been covered in a number of reports, including those of MacCallum, Beals and Wolbach.

These studies provide some background for an understanding of the cases of elderly patients, in which the cause is so often mysterious or undiscovered. It is notable that most of the hematomas labeled "spontaneous; cause unknown" have been reported as occurring in the aged, even though the largest single group of patients seems to comprise active young men with tumors clearly due to trauma or disease as aforedescribed. When one considers the weakness and distention due to age and obesity, remembers the role of heart disease and atheromatous vessels, and allows for the possible presence of hyaline degeneration that may not be clinically identifiable, one begins to understand how a strain from coughing or defecation can lead to rupture and hemorrhage.

Such a case has recently been described by Kinder. The patient was an elderly woman, obese and dyspneic, in whom griping pain in the upper part of the abdomen, with vomiting, was first diagnosed as obstruction of the large bowel. Operation revealed a large hematoma in the left rectus muscle (Fig. 4). Six days later the patient died of pulmonary embolism. Autopsy revealed a second hematoma on the opposite side. Kinder expressed the opin-

ion that this was the first case of the bilateral condition to be reported. It should be recalled, however, that the hematoma in Vogt's case was apparently bilateral, though of course the diagnosis was not directly verified by operation or autopsy. Wohlgemuth also reported 4 bilateral hematomas.

Collection and review of large numbers of cases have led to attempts at classification, or at least some sort of convenient grouping of the entity, whether on etiologic or clinical grounds. Among the more inclusive reviews may be mentioned those of Wohlgemuth (127 cases), Culbertson (41), Rose (32), and Teske (100). Teske's breakdown, with the number of cases in each group, is as follows: traumatic, 19; pregnancy, 22; disease, 6; idiopathic, 53 (patients mostly elderly). Keller cited an overall classification of (1) spontaneous hematoma and (2) traumatic hematoma and suggested instead that the tumors be the classification classed as (1) direct and (2) indirect, the second type being that for which a pathologic process has laid the groundwork for the immediate precipitating cause. Kapsinow noted that

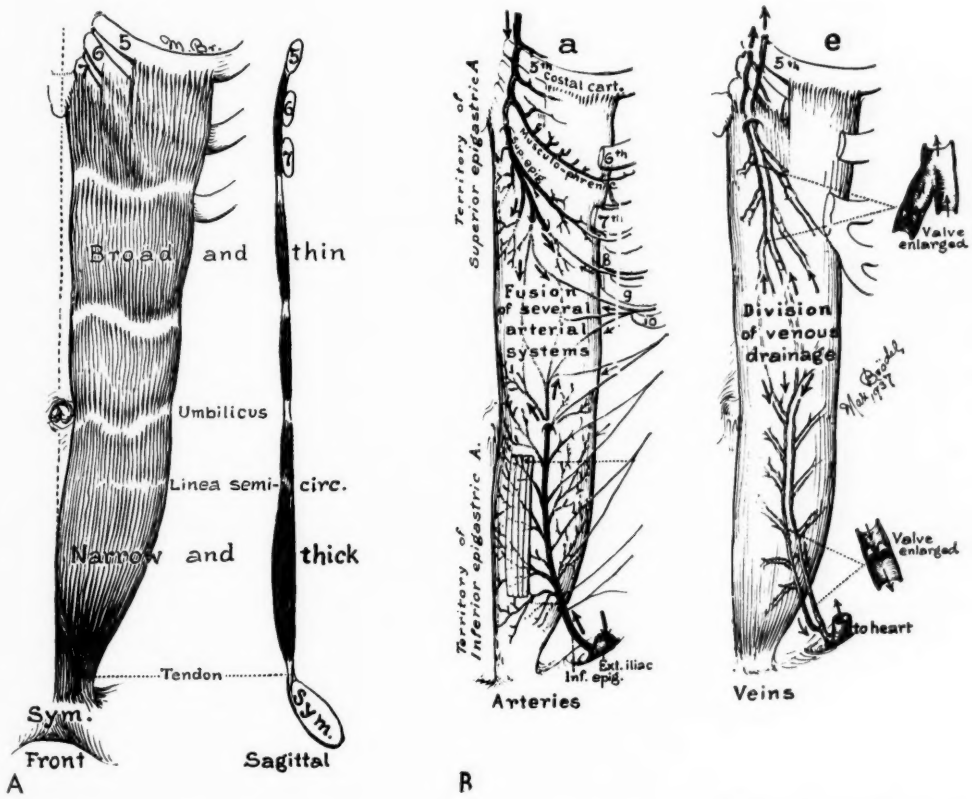

Fig. 2.—*A*, general topographic sketch of muscle mass. *B*, dorsal view; diagram of entire rectus circulation. Sketch *a* shows the main arteries feeding the muscle; sketch *e*, the principal veins and the direction of the blood flow. Except for the venules which drain the capillary network, all veins are double. *Reproduced by permission of the Johns Hopkins Press from Brodel, op. cit.*

in most of the cases in the literature the symptoms are divided between "acute" and "delayed," the slow or delayed growth of the hematoma indicating that some strain or weakening preceded the precipitating cause. This grouping is suggestive from the point of view of therapy—that is, when the diagnosis is certain and a choice is possible.

Signs and Symptoms.—The clinical picture presented by this type of hematoma, as revealed in the literature, shows considerable variety, which is not surprising when one considers the pathogenesis in the individual cases reported. It is possible, however, to enumerate the signs and symptoms that must be kept in mind.

Pain in the abdominal region is the most common early symptom. This may be mild or severe, generalized or localized. We shall refer to 1 case, however, in which there was complete absence of pain in the early stage. This type is easily accounted for when one recalls that the pain is associated with pressure of the clot, or fluid, within the muscle or its sheath, or between the muscle and the peritoneum, and that, when the hemorrhage is gradual, the early warning may be merely a vague feeling of discomfort. In severe involvement, with large tumors and much distention, there may be exquisite tenderness and hyperesthesia of the area. Many patients have presented an appearance of severe distress and acute illness.

Muscle rigidity is to be expected. Of Teske's series of patients, half showed rigidity of a quadrant or of the whole rectus on the affected side. In a few there was general rigidity of the abdomen. This condition frequently poses an important diagnostic problem, since it interferes with observation or palpation of the tumor mass. On the other hand, a case is recorded (Morgan) in which a hematoma in a 20-year-old man, precipitated by a dive in which the patient struck flat on the abdomen, caused such extreme tenderness that the area could hardly be touched, yet there was no rigidity or spasticity.

A mass is usually palpable, though it may not always be visible, especially in the obese patient. Sometimes it is definite, *resembling a hernia;* in Stoeckel's case, as has been mentioned, it was mistaken for the head of a fetus. It is important to try to localize this mass, though this is not always easy or possible. If it is palpable, one can test for *Bouchacourt's sign* by having the patient contract the recti. This is easily done by having him sit up from the supine position. The maneuver has been described in Vilar's excellent paper:

"In the first place by means of careful palpation we have found a small tumor; we must then establish whether its situation is parietal or internal. For this we have the patient contract the abdominal wall; if the tumor is subcutaneous, it becomes manifest, retaining and making more manifest its mobility with respect to the underlying muscular plane; if it is situated between the muscular layers, its characteristics do not change, but take on a peculiar firmness; finally those situated in the preperitoneal or intraperitoneal space disappear completely. But this useful maneuver loses its value in cases of flaccid abdominal walls such as those of multiparas, patients who are very obese, who have had ascites, etc."

Of course the maneuver is also hard to apply when the mass cannot be adequately palpated, owing to tenderness.

Another sign is *ecchymosis and discoloration* of the skin. It is reported that this is rare; if it is reported or elicited in the case history, however, it suggests muscular or vascular fragility. When it is observed in a patient at the time he presents himself, it is usually located not over the mass but just above the pubis, in the perineum, in the scrotum or in the labia

majora. More often it appears as a semicircle below the umbilicus, since at that spot the blood passes more easily around the medial border of the rectus (Aird). Furthermore, when it appears in the clinical picture it is usually a *rather late sign.* In Teske's series it appeared on the average four days after the onset of symptoms, though in a few cases it was visible when the patient first presented himself.

The *temperature range* is important. Usually it is normal or only slightly subnormal. On the second or third day after onset there may appear slight elevation, sometimes in association with leukocytosis.

Leukocytosis appears to be the rule. According to Teske, it was nearly always observed when the blood count was reported. The average leukocyte count was 11,600 per cubic millimeter; the highest in his series, 18,600 (78 per cent polymorphonuclears). In the same cases, platelets, bleeding time and coagulation time were within the normal range. The systolic blood pressure showed an average of 154 mm. of mercury and a maximum of 232 mm.; the diastolic pressure averaged 88 mm., with a maximum of 132 mm.

Nausea and vomiting are reported frequently. Vomiting with prostration is associated with rapid development of the hematoma.

Massive loss of blood may bring signs of *shock,* depending on the amount lost. In many cases the pulse is weak and rapid, and there are pallor and cold perspiration. Apparently Hobbs' patient died from shock and loss of blood.

In other cases, when the sheath has ruptured, staining of abdominal fat may not be seen until the skin is cut, but is then one of the first hints of the true diagnosis. In obscure conditions, however, the extravasation may not be evident until the sheath itself is incised (Cullen).

Differential Diagnosis. — Diagnosis is difficult in those cases in which there are signs of intra-abdominal disease and in which the history gives little hint of rupture or trauma. On the other hand, the diagnosis may not be difficult when the history causes a suspicion of muscular rupture.

*Diagnoses Made in Cases of Hematoma of the Rectus Abdominis Muscle**

	Cases
Hematoma of the rectus muscle (correctly diagnosed)	17
Ovarian cyst	22
Appendicitis	12
Ventral hernia	5
Intestinal obstruction	3
Gallbladder disease	2
Malignant tumor of the abdomen	2
Ectopic pregnancy	1
Tetanus	1
Desmoid tumor	1
Hydronephrosis	1
Twin pregnancy	1
Miscellaneous conditions	12
Diagnosis not given	20
Total	100

*From Teske, *op. cit.*, by permission of the American Journal of Surgery, Inc.

In only 3 of Culbertson's collection of 41 cases was the correct diagnosis made preoperatively. In Teske's series of 100 cases there were 17 correct preoperative diagnoses; in most of the other cases the condition was mistaken for intra-abdominal disease, and in a few for lesions of the abdominal wall. The distribution of the diagnoses in Teske's series is shown in the accompanying table. Santo Tomas has also presented an interesting table of diagnoses in each of 27 cases, including 4 of his own. Of these, 4 are correct (2 his own).

Of course, the *position of the hematoma* has much to do with the condition it simulates and with the diagnosis. In the greater number of cases it has occurred in the right lower abdominal quadrant, and this has accounted for diagnoses of *acute appendicitis, ovarian cyst with twisted pedicle, ovarian abscess* and *ruptured tubal pregnancy.* A hematoma in this location may also suggest *intestinal obstruction.* On the left side, low hematomas have been

mistaken for *hernia* or *thickening of the sigmoid.* In Kinder's case, already cited, the condition was diagnosed as an intestinal obstruction, though it occurred on the left. Hematomas above the umbilicus have led to diagnoses of *hydronephrosis or acute disease of the gallbladder.*

Coexisting disease or sequelae may also complicate the picture. This is one reason why the condition in pregnancy can be difficult to diagnose. Cases have been reported that offered even greater diagnostic puzzles. In Hughes' patient, aged 39 and pregnant, a kidney stone was demonstrated on the same side as the hematoma. Morgan's patient, a man aged 29, also had chronic inflammation of the appendix. In the case of Fothergill's patient, a woman aged 57, pelvic examination pointed to the probability of an ovarian cyst, while Bouchacourt's sign suggested trauma of the abdominal wall. Operation verified the presence of the coexisting conditions.

A detailed consideration of the differential diagnosis in the case here reported may throw some light on the situation so often faced.

The differential diagnosis was as follows: 1. *Acute appendiceal abscess,* suggested by the pain and palpable mass in the right lower quadrant, together with nausea and constipation. This was ruled out because of the previous appendectomy, normal leukocyte and differential counts, an afebrile temperature, and the palpable non-throbbing mass. 2. *Possible rupture of a right ovarian follicle.* This hypothesis was based on the pain in the right iliac region immediately after menstruation or concomitant with it, together with the absence of fever and leukocytosis. This was ruled out because the abdominal pain was unusually severe for rupture of an ovarian follicle, the definitely palpable mass indicated something more than a ruptured follicle, and the blood count showed no signs of anemia from intra-abdominal bleeding. 3. *An ectopic pregnancy* was thought possible because of the abdominal mass, together with sudden severe pain in the right lower quadrant, with nausea and fainting. This was ruled out for lack of any symptoms of pregnancy, such as amenorrhea, or any evidence of pregnancy in the breast or on vaginal examination; also there was no anemia or positive blood chemical evidence of hemorrhage. 4. *Right ureteral disease* was considered but not kept in mind, in spite of the increased urination associated with the beginning of the pain and the radiation of the acute pain to the right lumbar area; the pain was not of the colicky type characteristic of ureteritis or ureterolithiasis, and the urine was normal. 5. The possibility of a *ruptured viscus* was also rejected, in spite of the severe abdominal pain, the history of trauma and the palpable tender mass. It was noted that the patient could not remember the date of her last abdominal trauma—evidently it had occurred a good while before the onset of the severe abdominal pain. In addition, there was no fever and no leukocytosis. 6. *An acute pelvic infection* was suggested by the full and tender right adnexae, but this was rejected because there was no history of venereal disease and no leukorrhea, and the pain was unusually severe for this condition. 7. A *ruptured aneurysm* of the right deep epigastric blood vessels was also suspected, in view of the history of repeated old abdominal trauma, which might have predisposed to this accident. The diagnosis was not thought valid, however, because the patient had not noticed any thrill or throbbing prior to the onset of acute pain. (In taking a history, however, one should keep in mind that a patient may not be very observant about such a sign as a thrill, especially when the abdomen is thick.) 8. The history of *prolonged bleed-*

ing after tooth extraction a year earlier, and the unusual bleeding from the hand scratch the month previous, suggested that there might be some *intraperitoneal or extraperitoneal abdominal disease* consequent to blood dyscrasia. The diagnosis was not seriously considered, since there had been no spontaneous bleeding of the mucous membranes or the skin. Nor had there been any history of serious petechiae or ecchymosis on any part of the body, except the occasional hematoma that resulted from bumping the right hip and the illiac region.

A comparison of these differential diagnostic possibilities with the true lesion illustrates how the acute abdominal symptoms attending a hematoma of the lower rectus can easily hoodwink even the most careful abdominal surgeon. The exact pathologic condition in this case also remains unexplained. Possibly it was due to a ruptured aneurysm of a deep epigastric vessel, subsequent to repeated old contusion with hematoma. The patient may easily have missed the important "thrill" or throbbing sensation prior to the acute attack of pain. Again, some blood dyscrasia or weakening of the blood vessel walls, particularly of the deep epigastric vessels, is certainly possible; the history of prolonged bleeding gives support to this view. It should also be noted, however, that the bleeding and coagulation times were normal, both immediately after the operation and six days later. The platelet count would normally be expected to show an increase immediately after the operation, and it did so, reading 468,000 —a definite increase. Yet this would be unexpected in any bleeder's disease, for in the presence of such a condition neither operation nor any active bleeding will produce much increase in the platelet count.

The final diagnosis, therefore, was intramuscular hematoma of the right lower rectus abdominis, probably secondary to rupture of a deep epigastric aneurysm or to some blood dyscrasia of undetermined cause.

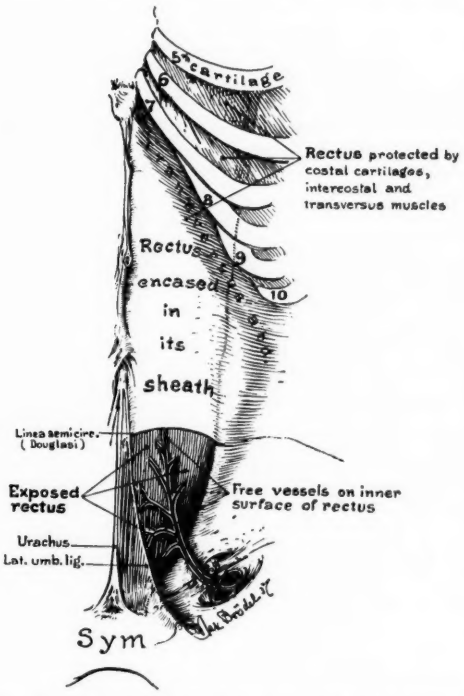

Fig. 3.—Vulnerability of dorsal surface of lower rectus. *Reproduced by permission of the Johns Hopkins press from Brodell, op. cit.*

One may thus reemphasize the importance of a careful and detailed case history in the diagnosis of this condition. The examining physician must, of course, have the possibility in mind in any case of abdominal pain following an injury or exertion, even if slight, and certainly when there is a palpable mass. But even when this possibility is kept in mind, he may easily misdiagnose the condition by overlooking the presence of trauma, muscular weakness or other predisposing conditions when these are not definitely reported. Indeed, it may take persistent questioning to insure that the patient will recall such

incidents. An example is the case reported by Kapsinow:

"The patient was a white woman, aged 64, with persistent pain and a lump in the right lower quadrant. The correct diagnosis was confused by the patient's obesity, which made palpation difficult, by the absence of tenderness, lack of any history of trauma, and history of repeated appendicitis attacks. Operation revealed clotted and oozing blood in the right rectus muscle, and since the patient was under spinal anesthesia, she was questioned further regarding trauma. Only then was it learned that the first sharp pain in the right lower abdomen had occurred when she had attempted to turn the mattress of her bed by herself. The author concludes: 'The interesting features in this case were the apparent insignificance the patient placed upon the trauma as the cause of her trouble, the slowness in the development of the mass and the history of repeated attacks of appendicitis'."

Another interesting case in point is one reported by Vilar, in which the origin of the hematoma was obscure and the beginning of the process completely painless:

"The patient in this instance was a colleague, who one day happened to feel his abdomen and noticed in the right iliac fossa a tumor which seemed to be appendicular. At this time it was absolutely painless. Three months later it had developed to a hard tumor, and was somewhat painful. Vilar states: 'The patient was now questioned more carefully on the antecedents, and remembered having noticed a bruise in the affected region about a month before the beginning of the process. This he attributed to some bump against the furniture.' The author then surmised that the minute trauma might have determined the appearance of the process in a weakened area, or more probably, the ecchymosis was due to blood passing from a hematoma thru the orifices of the anterior rectus sheath to the subcutaneous tissues. A hematoma within the rectus sheath was thus suspected. The tumor was removed surgically shortly afterwards. It is also interesting that in this case, the spontaneous hematoma had evolved to aseptic suppuration, which explained the hardness to palpation."

Another case in which a tender abdomen made the correct diagnosis difficult was reported by Keller. This is also interesting because the patient was a 19-year-old girl.

"The pain in both lower quadrants was so excruciating and the abdomen so tender that a differential diagnosis could not be made by rectal examination. The tentative diagnosis was (1) acute appendicitis, (2) torsion of right ovarian cyst, (3) in view of a vaginal discharge, right pyo- or hemosalpinx. On operation, a formed clot was found immediately under the superficial fascia, and the right rectus totally torn and bleeding four to five finger breadths above the symphysis pubis. The torn sheaths were pulled together without touching the muscle fibers. Eight weeks after discharge, the abdomen showed no limitation of movement in the area."

In view of this history, the author points out that rectus hematoma should be considered in the differential diagnosis when there is no history of pelvic disease, the general health is unaltered, there is no fever, and no signs of serious abdominal conditions are present, such as serious peritoneal involvement.

Treatment.—Hematomas of the rectus abdominis have been treated with success by conservative measures as well as by operation. Although the latter treatment is more frequent, many operations have been undertaken to clarify a doubtful diagnosis, or in the expectation of encountering some other condition.

On the other hand, considerable numbers of patients in whom hematomas developed

because of trauma during military training were given conservative treatment and recovered, without exception. Notable are two series totaling 59 patients (Bowers and Richard; Fruin and McLaughlin).

Teske has summarized the indications for conservative treatment. The patient should be young, the hematoma small and of traumatic origin, and the muscle and arteries be normal. Treatment consists of the application of ice bags, bed rest, and the administration of sedatives. A hot water bottle or compress may be used when danger of further hematoma is past.

Operative intervention is indicated when there is abscess or repeated hemorrhage; exporatory operation is indicated if the diagnosis is unclear. In these conditions, the earlier the operation the better, as the hematoma may spread with delay, and the anatomic nature of the region permits it to become quite large.

A paramedian incision may be made directly over the palpable mass. The sheath is usually opened and the muscle split, if necessary, to remove the clot. If spurting or oozing vessels are discovered, they should be ligated above and below the point of bleeding. Bleeding from the muscle may be checked with mattress sutures of catgut. It may be necessary to drain the opening if there are torn and oozing muscle ends. Closure without drainage is preferable and is usually possible when the area is dry and free from infection. As a rule the peritoneum is not opened unless the hematoma has extended into the abdominal cavity or there are intra-abdominal complications.

Sometimes the clot is so intimately imbedded in the muscle that it cannot be evacuated. When it is inconvenient to remove the hematoma and the patient's condition is favorable, the mass may be left *in situ* and treated conservatively. Even large masses have been treated in this way with success.

In a case reported by Gerstman, a hematoma developed in a pregnant woman aged 24 shortly before the commencement of labor. The similarity to a threatened rupture of the uterus indicated cesarean section, which revealed a large hematoma within the muscle fibers, extending from the symphysis to the umbilicus. The baby was delivered successfully, and the hematoma was not removed but was treated conservatively. There was a slight infiltration at the site of the hematoma when the patient left the hospital, but four weeks

Fig. 4.—Hematoma of rectus muscle. Posterior aspect and muscle, showing the hematoma and the inferior epigastric vessels (arrow). *Reproduced from Kinder, op. cit., by permission of John Wright and Sons, Ltd.*

later she stated that she was feeling well.

SUMMARY

1. A case of hematoma of the rectus abdominis in a 35-year-old woman is reported. Smarting symptoms apparently began a week before admission, with gradually increasing painful paroxysms. Pain on admission was extreme. Clinical and roentgen observations suggested a twisted ovarian cyst or some other soft tissue structure. Operation revealed the hematoma, which was evacuated. The cavity was packed with gauze later removed fractionally. Recovery was uneventful. Possible etiologic factors, suggested by the case history and examination, were repeated slight contusions, rupture of an epigastric aneurysm and undetermined blood dyscrasia.

2. A review is presented of the anatomic and etiologic background, diagnosis and treatment of this type of hematoma, which so often mimics intra-abdominal disease.

3. Comparable cases from the literature are also reviewed with a view to their bearing on the differential diagnosis. It is emphasized that a careful and searching case history may unearth half-forgotten factors, such as slight contusions, strains, and signs of slight blood dyscrasia, which may suggest the correct diagnosis. Patient and repeated inquiry is therefore necessary in any case of abdominal complaint of dubious diagnosis.

RÉSUMÉ

1. L'auteur rapporte un cas d'hématome du muscle abdominal droit chez une femme de 35 ans. Des symptômes progressivement douloureux débutèrent une semaine avant son admission à la clinique. A l'entrée, la douleur était extrême. Les examens cliniques et radiographiques firent penser à un kyste de l'ovaire tordu. L'opération révéla un hématome. Guérison.

2. On passe en revue l'étiologie, l'anatomie, le diagnostic et le traitement de ce type d'hématome qui simule si souvent une maladie intra-abdominale.

3. On discute le diagnostic différentiel et on insiste sur une anamnèse qui doit être bien fouillée, car elle découvre parfois des contusions oubliées, des signes discrets de dyscrasie sanguine etc.

4. La progession de la maladie est un facteur important dans le pronostic.

5. A la lumière des connaissances actuelles, les tumeurs à cellules de Hürthle devraient être suspectées de malignité.

6. L'extirpation totale du cancer de la thyroïde est le traitement idéal. Si le cancer est inopérable, on le traitera par les rayons X (haut voltage).

ZUSAMMENFASSUNG

1. Es wird über einen Fall von Bluterguss im M. rectus abdominis bei einen 35jährigen Frau berichtet. Schmerzhafte Erscheinungen setzten offenbar eine Woche vor der Krankenhausaufnahme ein und steigerten sich allmählich zu heftigen Schmerzanfällen. Bei der Aufnahme bestanden unerträgliche Schmerzen. Die klinische Untersuchung und Röntgenaufnahmen liessen eine gedrehte Eierstockszyste oder eine andere Weichteilsgeschwulst vermuten. Die Operation brachte das Hämatom zutage, das entleert wurde. Die Höhle wurde mit Gaze ausgefüllt und später stückweise entfernt. Genesung erfolgte ohne Zwischenfälle. Als mögliche ursächliche Faktoren wurden auf Grund der Anamnese und der Untersuchung wiederholte leichte Quetschungen, ein geplatztes epigastrisches Aneurysma und unbestimmte Bluterkrangung in Erwägung gezogen.

2. Es wird ein Überblick über die anatomischen und ätiologischen Hintergründe und über die Diagnose und Behandlung dieser Form des Blutergusses, die häufig eine innere Baucherkrankung vortäuscht, gegeben.

3. Ferner wird auf ähnliche Fälle in der Literatur mit Berücksichtigung ihrer Bedeutung für die Differentialdiagnose eingegangen. Es wird hervorgehoben,

dass eine sorgfältige Anamnese halb vergessene Tatsachen wie leichte Quetschungen, Zerrungen und Zeichen geringfügiger Bluterkrankungen ans Tageslicht bringen und auf diese Weise zu einer richtigen Diagnose leiten kann. In jedem Falle von unklaren Bauchbeschwerden ist Geduld und wiederholte Befragung des Kranken notwendig.

RIASSUNTO

1. Viene descritta un'osservazione di ematoma del muscolo retto in una donna di 35 anni, nella quale i disturbi cominciarono una settimana prima con parossismi dolorosi ingravescenti. Al momento dell'ingresso il dolore era terribile; si pensò alla torsione di una cristi ovarica. All'intervento si trovò l'ematoma, lo si svuotò e la cavità fu riempita di garza. Guarigione. Si crede che la causa sia rappresentata da traumi minimi ripetuti, o da rottura di un aneurisma dell'arteria epigastrica o da una sindrome discrasica ematica.

2. Viene trattata l'anatomia, l'etiologia, la clinica e la cura dell'affezione, che così da vicino simula affezioni intraddominali.

3. Vengono raccolti dalla Letteratura casi analoghi. Si sottolinea la necessità di un'indagine anamnestica accurata per raccogliere elementi eventualmente dimenticati, quali piccoli traumi, segni minimi di emodiscrasia, ecc.

SUMARIO

1. É apresentado um caso de hematoma do rectus abdominis numa mulher de 35 anos de idade. Os sintomas de dôr começaram aparentemente uma semana antes de sua admissão ao hospital, com paroxismos dolorosos gradualmente progessivos. A dôr era extrema por ocasião da internação. Observações clínicas e radiológicas sugeriram uma torção de cisto de ovário ou de outra estrutura tissular mole. A operação revelou presença de hematoma, que foi retirado. A cavidade foi enchida de gaze, depois removido fracionàriamente. O restabelecimento decorreu sem incidentes. Possíveis fatores etiológicos, sugeridos pela história do caso e pelo exame forma, contusões leves repetidas, ruptura de um aneurisma epigástrico e a discrasia sanguínea indeterminada.

2. É apresenta da uma revisão da base anatômica e etiológica, diagnóstico e tratamento dêste tipo de hematoma, que tão freqüentemente imita a afecção intra-abdominal.

3. Casos comparáveis da literatura também são revistos especialmente com relação ao diagnóstico diferencial. É frizado que a anamnese cuidadosa da doença poderá revelar fatores semi-esquecidos, como as contusões leves, os excessos e sinais de discrasia sanguínea leve, que podem sugerir o diagnóstico correto. O inquérito paciente e repetido é portanto necessário em qualquer caso de queixa abdominal de diagnóstico duvidoso.

RESUMEN

1. Se comunica un caso de hematoma del músculo recto anterior del abdomen en una mujer de 35 años de edad. Los síntomas aparecieron una semana antes de su ingreso, con paroxismos dolorosos graduales. El dolor era muy intenso al ser admitida. La observación clínica y roentgenológica sugirió un quiste ovárico con pedículo torcido. La operación reveló el hematoma que fué evacuado. La cavidad fué taponada con gasa que posteriormente fué desalojada fraccionadamente. La recuperación se llevo a cabo sin accidentes ó complicaciones. Se sugieren posibles factores etiológicos por la historia y examen físcio del caso, contusiones ligeras repetidas, ruptura de un aneurisma de la epigástrica y discrasia sanguínea no determinada.

2. Se presenta una revisión desde el punto de vista anatómico y etilógico, diagnóstico y terapeútico en este tipo de hematoma que presenta tan frecuentemente enfermedad intrabdominal.

3. Se revisan tambien casos similares comunicados en la literatura, enfocando el diagnóstico diferencial. Se señala que una historia obtenida cuidadosamente puede descubrir factores tales como contusiones

ligeras, esfuerzos y signos de discrasias sanguíneas, que pueden sugerir el diagnóstico correcto. El interrogatorio paciente y cuidadoso, es por lo tanto necesario en cualquier caso de molestia abdominal de diagnóstico dudoso.

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Cardiac Rupture During Heart Massage

Ventricular Standstill Following Administration of Procaine Amide

IGOR F. NIKISHIN, M.D.*

CANTON, OHIO

THE great emotional appeal and the dramatic results of the treatment of cardiac arrest have captured the attention of many investigators. The knowledge thus gained aids in the understanding of the causes of cardiac stoppage and makes possible physiologically sound prophylaxis and treatment of uncomplicated cardiac arrest.

Little is known, however, about the complications resulting from the treatment of cardiac heart standstill. The purpose of this paper is to bring to the reader's attention some of the possible complications arising during a treatment of cardiac arrest, as illustrated by a clinical case.

REPORT OF CASE

A 74-year-old white woman, small and emaciated but mentally alert, was admitted to Aultman Hospital complaining of abdominal enlargement, moderate shortness of breath on exertion, occasional heart palpitation and, recently, swelling of both ankles.

A colloid nodular goiter was present. The heart was somewhat enlarged to the left; systolic and diastolic murmurs were heard over the aortic area; the rate was regular, 110 per minute; the blood pressure in millimeters of mercury was 132 systolic and 50 diastolic, and the pulse was hard. The respiratory rate was 24 per minute. The abdomen was enormously enlarged, containing loculated fluid, of which 24,000 cc. was removed on admission. Cytologic examination revealed malignant cells.

An electrocardiogram revealed sinus tachycardia, absence of the R wave in V2, a P-R interval of 14 and a QRS of 0.08.

But for the signs of moderate hepatocellular damage, the blood chemical values and blood electrolytes were within normal limits. The blood count revealed marked anemia, lymphopenia and leukocytosis. The sedimentation rate was elevated, and the platelet count was normal.

After the usual preparation with blood transfusions, vitamins, electrolytes and fluids, as well as prophylactic administration of antibiotics, the patient was operated on for intra-abdominal malignant tumor. Preanesthetic medication consisted of 0.2 Gm. of chloral hydrate, 0.005 Gm. of morphine and 0.0005 Gm. of atropine; 12 mg. of Pantocain in 10 per cent dextrose was used for spinal anesthesia; this was injected into the fourth lumbar interspace and reached the level of the xyphoid process.

Within ten minutes after the induction of spinal anesthesia, a fall of blood pressure from 150 systolic and 70 diastolic to zero was noticed by the anesthetist. The radical pulse became unobtainable; the respirations ceased, and the skin incision stopped bleeding.

The left half of the diaphragm was palpated through the incision in the peritoneum, and the pericardium was then exposed through a separate incision in the fifth intercostal space to the left of the sternum. No bleeding from this incision was encountered, and the heart was in standstill.

Cardiac massage was begun; oxygen was supplied by endotracheal tube, and the blood pumped into the cubital vein, positive pressure being used.

Within five minutes the heart resumed its action, but the beat soon became weak, and a second standstill occurred ten minutes later. The pericardium was then incised, and a small, flabby heart was discovered in asystole. It was grasped with the right hand, the surgeon standing to the right of the patient, and the massage was resumed. Five-tenths cc. of 1:1,000 aqueous solution of epinephrine was in-

*Former Chief Resident in Surgery, Aultman Hospital, Canton, Ohio.

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jected into the right ventricle, to which the heart, almost immediately, responded by a strong and regular action. Two minutes later ventricular fibrillation began. The fibrillation was interrupted by injection of 2 per cent procaine hydrochloride into the right ventricle.

A pool of venous blood in the pericardial sac was noticed during the ensuing standstill, and a 2 cm. tear near the apex of the anterior wall of the right ventricle was detected. The leak was controlled by two No. 00 chromic catgut figure-of-eight sutures. The cardiac massage resumed, and this was followed immediately by resumption of cardiac activity. A cycle of regular cardiac action followed by ventricular fibrillation, standstill, massage and regular heart activity then became established, and lasted for the next thirty minutes. The duration of regular cardiac activity increased with each period, and, though no pulsation of the radial artery was palpable, the color of the skin remained normal, the pupils were contracted and pulsations of the thoracic portion of the aorta became increasingly stronger. Fifty minutes had elapsed since the beginning of resuscitation, when, after a prolonged period of satisfactory cardiac action, ventricular fibrillation reappeared. Two hundred mg. of procaine amide (Pronestyl®) was administered slowly by vein. Within two minutes of the injection the fibrillation ceased abruptly. The instantaneous effect was similar to that of the electric defibrillation observed in dog experiments. The cardiac standstill was now irreversible, and no amount of massage, either alone or supplemented by injections of epinephrine could start the heart.

Pertinent observations at the autopsy were as follows: The operative diagnosis of intra-abdominal malignant disease was confirmed by demonstration of papillary cystadenocarcinoma of the right ovary, metastatizing to the peritoneum, liver and lungs. Moderate atherosclerosis was observed, also in the coronary vessels. The myocardium was soft, light brown. The terminal branch of the left coronary artery seemed to be occluded. A 2.5 cm. sutured tear was noted in the anterior wall of the right ventricle. Microscopically the myocardial fibers appeared to be swollen, indistinct in outline and with increased perinuclear pigment. The interstitial tissue was edematous and contained areas of hemorrhage and foci of fibrosis. Sections through the ruptured myocardium showed recently extravasated red blood cells. Fibrosis was marked in the general area of the rupture.

Comment.—The many factors capable of leading to functional insufficiency of the heart, commonly called "cardiac arrest," may be considered to form two groups: factors causing interference with cardiac impulse and factors changing the physiologic response of the heart muscle.

Hyperactivity of the carotid sinus, the stimulation of that organ by pressure, manipulation around the aortic arch and direct stimulation of the vagus nerve, form the first group of factors. The second group is represented by hypoxia of the myocardium, due to anoxemia or ischemia; electrolyte imbalance; disturbance of hormonal balance, and the pharmacologic effect of certain drugs which change the response of the heart muscle to cardiac impulse.

There seems no reason to believe that factors of the group mentioned first were operative in the case reported here. No manipulations were carried out anywhere near the vagus nerve or the carotid sinus, and the patient responded well after the positioning on the operating table. The preoperative investigation failed to reveal any electrolyte deficiencies, (especially, no hypopotassemia was present); no signs of hormonal imbalance were detected, and no signs of anoxemia were noted. No drugs were used which were known to change the myocardial response. There was, however, a history of cardiac embarrassment, elicited on admission, pointing toward possible myocardial ischemia. This condition could only be aggravated by hypotension resulting from the spinal anesthesia[1] and reducing the coronary blood flow.

The etiologic factor leading to cardiac standstill in the case presented seems, therefore, to have been myocardial ischemia following hypotension resulting from spinal anesthesia.

Because the diagnosis can be made only by direct palpation or visualization of the heart, exposure of the heart should be the

first rather than the last step in the effort to diagnose suspected cardiac standstill.

In the case reported the diagnosis was suspected from collapse of the peripheral circulation, absence of bleeding from the operative incision and failure to palpate a pulsating heart through the diaphragm. The diagnosis was established by exposing the pericardial sac through a thoracic incision.

Propulsion of oxygenated blood, the first goal of treatment of cardiac arrest, was achieved by extrapericardial massage, endotracheal intubation, artificial respiration and blood transfusion. The pupils remained contracted, and the skin resumed its natural color.

Although a sharp blow against the pericardium might be sufficient to start a heart at standstill,[2] the logical requirement for resumption of sustained cardiac activity is satisfactory oxygenation of the myocardium. This was apparently inadequate in the reported case. The heart resumed its action within minutes after the beginning of cardiac massage, but came to a standstill a second time ten minutes later. Even direct massage of the heart was unsuccessful in this instance. Intracardial injection of epinephrine was followed by immediate resumption of cardiac activity; but it also had originated a cycle of regular action followed by ventricular fibrillation, injections of procaine hydrochloride, standstill, massage and regular action again.

While the intramyocardial injection of procaine hydrochloride, in the absence of an electric defibrillator, can be accepted as a necessary measure, the wisdom of injecting epinephrine is questionable. The weak and flabby heart muscle of the patient in the case here reported, however, was apparently unable to provide a systole vigorous enough to ensure adequate oxygenation of itself, thus justifying the use of a cardiac "whip."

A balance between the oxygen requirement and the oxygen supply must have been achieved, for the cardiac standstill remained reversible, and the skin well colored, and the periods of regular cardiac activity lasted longer with the duration of resuscitation.

GENERAL COMMENT

Rupture of the Heart During Cardiac Massage.—The danger of a crushing injury to the massaged heart is real and increases with the force exerted to compress the heart and with the extent of any myocardial damage that may be present prior to treatment. The cause of the injury may be the sudden impact of the grasping hand, the pressure of the surgeon's fingers, or the gliding movements of the surgeon's hand. Lack of synchronization of the massaging movements with the incipient cardiac action further increases the possibility of trauma.

To my knowledge, only 2 cases of cardiac rupture during heart massage have been reported,[3] though ecchymosis, hemorrhage and hemorrhagic necrosis resulting from heart massage have been described as occurring both in animal experiments[4] and in man.

The lack of information about the case of cardiac rupture mentioned by Johnson and Kirby[3a] does not permit its comparison to the case reported here. It seems noteworthy, that their patient was 74 years of age and that the rupture occurred after the pericardial sac was entered.

The cardiac rupture reported by Hurwitt[3b] occurred in a 69-year-old woman known to have had arteriosclerotic heart disease. The pericardial sac was entered, and it was the surgeon's impression that his thumb had penetrated the myocardium through an area of fatty infiltration; this was later microscopically confirmed. The patient in the case reported here was also an elderly white woman with a diseased myocardium. Cardiac massage through

the pericardium did not result in rupture of the heart, as was evidenced by the absence of blood in the pericardial sac when this was later entered. The leak was noted after massage had been applied directly to the heart.

The mechanism of the rupture remains uncertain. Laceration of the myocardium is known to have followed blunt injury to the heart,[6] and spontaneous rupture of the heart may be due to a sudden increase of intracardial pressure or scattered myocardial hemorrhages.[6a] The continuity of the muscle bundles in the heart is such that the application of sudden tension at one point may result in a rupture at a considerable distance from it, thus making the site of the laceration a rather unreliable evidence of its causation. The rupture in the case here presented occurred through the anterior wall of the right ventricle and in an area of increased focal fibrosis. It was the surgeon's impression that he did not enter a cavity with any of the massaging fingers.

It seems improbable that spontaneous rupture should occur in a weak and flabby heart muscle; this suggests that the injection of epinephrine immediately prior to the massage that led to rupture may have had etiologic importance. The sudden change in the muscle tonus and the trauma of the injection, as well as the resulting increase in intracardiac pressure, may well have been important, if not decisive, factors leading to cardiac rupture.

The management of cardiac laceration during a massage of the heart does not differ from treatment of a myocardial tear occurring under different circumstances. Elaborate procedures are obviously unnecessary, and the tear should be closed with a few sutures placed through the thickness of the myocardium, the branches of coronary vessels being avoided. The marked friability of the heart muscle does not permit the use of clamps or forceps.

The suturing of the myocardium had no apparent effect on the cardiac activity, which is not surprising in view of the known tolerance of the heart muscle to mechanical injury.

In all 3 reported cases the rupture followed direct massage of the heart and occurred in elderly persons with disease of the myocardium. In the 2 cases reported in more detail, injection into the myocardium had been made prior to the rupture. Hurwitt[3b] injecting calicum chloride, and epinephrine being used by myself. It remains unknown whether the drug injected or the stimulus of the injection, or both, contributed to the causation of cardiac rupture.

In view of those observations, it seems appropriate to warn against entering the pericardial sac and against intracardiac injections during the treatment of cardiac arrest in elderly patients with diseased hearts.

Ventricular Standstill Following Intravenous Injection of Procaine Amide.—The known effect of procaine amide, which makes that drug so valuable in the treatment of cardiac arrhythmias, consists mainly in depression of ventricular activity by reducing ventricular conductivity, depressing the basic idioventricular pacemaker,[7] and increasing the threshold for stimulation of the myocardium.[8] The exaggeration of this effect results in ventricular asystole, as demonstrated both in animal experiment[9] and in man,[10] and leading to a fatal outcome in some cases.[11] In many cases the drug was used in dying patients, thus making impossible a reliable evaluation of its role. However, a causal relation between a cardiac arrest and the intravenous administration of procaine amide was satisfactorily demonstrated by Weingarten.[10c]

The effect of intravenously injected procaine amide was observed directly on the exposed heart in the case reported here.

Within two minutes after an intravenous injection of 200 mg. of procaine amide (Pronestyl®) ventricular fibrillation stopped quite abruptly, the ventricles remaining still and in diastole. The standstill was irreversible, as no amount of massage, either alone or supplemented by injections of epinephrine, was successful in starting the heart again.

The damage to the patient's liver, as demonstrated by preoperative investigation, might have been a factor in her response to a moderate dose of procaine amide. The poor condition of her heart, due both to the underlying disease and to prolonged effects toward resuscitation, might well have been the cause of the terminal cardiac standstill. However, the abruptness of the end, the short time that elapsed between the injection and the ventricular standstill and the known effect of the drug point to a possible causal relation between the intravenous administration of procaine amide and cardiac standstill in this case.

A word of caution seems therefore to be warranted whenever the intravenous injection of procaine amide is being considered for elderly patients with known hepatic damage.[12]

SUMMARY

A myocardial rupture was observed during the treatment of cardiac arrest by direct massage of the heart. Suturing of the myocardium had no observable deleterious effect on cardiac action. The resuscitation was terminated by an irreversible ventricular asystole following an intravenous injection of 200 mg. of procaine amide (Pronestyl®).

The causation, the diagnosis, and the treatment of cardiac arrest in the case presented are commented upon, and cardiac rupture, as well as the effect of procaine amide on the myocardium is discussed.

The following conclusions are suggested: In the treatment of cardiac arrest in elderly patients the massage should be extrapericardial; intramyocardial injections should be avoided, drugs sharply increasing the tonus of the heart muscle should not be used, and the indication for intravenous administration of procaine amide should be evaluated with extreme caution.

RESUMEN

Se observó una ruptura del miocardio durante el tratamiento de paro cardíaco por masaje directo del corazón. La sutura del miocardio no tuvo efectos nocivos sobre la acción cardíaca. La resucitación se terminó por una asistolia ventricular irreversible siguiente a una inyección intravenosa de 200 mg. de procainamida (Pronestyl).

Se presenta y comenta la causa, diagnóstico y tratamiento del paro cardíaco en el caso, la ruptura cardíaca y el efecto de la procainamida sobre el miocardio.

Se sugieren las siguientes conclusiones: El masaje debe ser extrapericárdico en el tratamiento de los pacientes viejos con paro cardíaco; deben evitar se las inyecciones intramiocárdicas, no deben usarse las drogas que aumentan bruscamente el tono del músculo cardíaco y debe valorarse con extremo cuidado la indicación para la administracción intravenosa de procainamida.

RIASSUNTO

Durante assaggio cardiaco diretto per arresto del cuore si verifico la rottura del miocardio. Venne eseguita una sutura senza che si creassero effetti dannosi sull'attività cardiaca. Il tentativo di risuscitazione terminò con una asistolia ventricolare irreversibile consecutiva a iniezione endovenosa di 200 mg. di procainamide (Pronestyl).

Segue un commento sul caso (causa, diagnosi e cura dell'arresto cardiaco) e sulla rottura del cuore, come pure sugli effetti della procainamide.

Vengono tratte le seguenti conclusioni: nella cura dell'arresto cardiaco in pazienti anziani il massaggio deve essere extrapericardico; si deve evitare ogni iniezione intra-miocardica; non si devono usare farnaci che aumentino sensibilmente il tono del muscolo cardiaco; le indicazioni per l'uso della procainamide debbono essere vagliate con estrema cautela.

RÉSUMÉ

Description d'un cas de rupture du myocarde durant le massage direct du coeur pour arrêt du coeur. La suture du myocarde n'a pas eu d'effets nocifs secondaires sur la fonction cardiaque. Après réanimation, asystolie ventriculaire irréversible à la suite d'une injection intraveineuse de 200 mg de Pronestyl.

L'auteur commente la cause, le diagnostic et le traitement de l'arrêt du coeur dans ce cas, ainsi que l'effet du Pronestyl (procaine amide) sur le myocarde.

Conclusions: chez les malades d'un certain âge, le massage du coeur devrait être extrapéricardiaque; les injections dans le myocarde devraient être évitées, ainsi que les médicaments augmentant fortement le tonus du muscle cardiaque; les indications de l'administration intraveineuse de procaine amide devraient être posées avec la plus grande prudence.

ZUSAMMENFASSUNG

Während der Behandlung eines Herzstillstandes mit direkter Herzmassage wurde eine Zerreissung des Herzmuskels beobachtet. Das Nähen des Myokardiums hatte keine sichtbaren Schädigungen der Herzaktion zur Folge. Die Wiederbelebung scheiterte an einer irreversiblen Asystole der Herzkammern, die nach intravenöser Einspritzung von 200 mg Prokainamid (Pronestyl) auftrat.

Die Ursache, die Diagnose und die Behandlung des Herzstillstands im vorliegenden Falle werden besprochen, und auf den Herzmuskelriss und auf den Effekt des Prokains auf das Myokardium wird eingegangen. Die Schlussfolgerungen sind, dass bei älteren Kranken mit Herzstillstand die Massage extraperikardial ausgeführt werden soll, dass Einspritzungen in die Herzmuskulatur zu vermeiden sind, dass Medikamente, die den Tonus des Herzmuskels plötzlich steigern, nicht angewandt werden sollten, und dass die Indikation zur intravenösen Verabreichung von Prokainamid mit äusserster Vorsicht und Zurückhaltung gestellt werden muss.

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When we survey the long development of mankind from a rare hunted animal, hiding precariously in caves from the fury of wild beasts which he was incapable of killing; subsisting doubtfully on the raw fruits of the earth which he did not know how to cultivate; reinforcing real terrors by the imaginary terrors of hosts and evil spirits and malign spells; gradually acquiring the mastery of his environment by the invention of fire, writing, weapons, and at last science; building up a social organization which curbed private violence and gave a measure of security to daily life; using the leisure gained by his skill, not only in idle luxury, but in the production of beauty and the unveiling of the secrets of natural law; learning gradually, though imperfectly, to view an increasing number of his neighbors as allies in the task of production rather than enemies in the attempts at mutual depredation—when we consider this long and arduous journey, it becomes intolerable to think that it may all have to be made again from the beginning owing to failure to take one step for which past developments, rightly viewed, have been a preparation . . .

The present moment is the most important and most crucial that has ever confronted mankind. Upon our collective wisdom during the next twenty years depends the question whether mankind shall be plunged into unparalleled disaster, or shall achieve a new level of happiness, security, well-being, and intelligence. I do not know which mankind will choose. There is grave reason for fear, but there is enough possibility of a good solution to make hope not irrational. And it is on this hope that we must act.

—*Russell*

Clinical Anatomic Aspects of Radical Hepatic Surgery

JOHN E. HEALEY JR., M.D., M.I.C.S.

PHILADELPHIA, PENNSYLVANIA

SURGICAL resection of a part of the liver is not a new operative procedure, although many are inclined to believe so because of the fact that it is a relatively infrequent one. As early as 1899, Keen[1] reviewed the world literature and found that a total of 76 cases of surgical removal of hepatic tumors had been reported up to that time, including 3 of his own cases. The first such case that he cited was described by Luis[2] in 1886, and it was exactly two years later (1888) that the first comprehensive study was carried out on the intrahepatic gross anatomy by means of the injection-corrosion technic by Rex.[3] Unfortunately, most of this work was related to mammals other than man and therefore did not contribute a great deal to the surgical anatomic knowledge of the liver. It did indicate, however, that gross anatomists were again becoming interested in this organ, since surgeons had shown the feasibility of resection of its parts.

Early interest in hepatic surgery reached its peak in 1897; 14 cases of partial hepatectomy were reported in that year alone. At that time Keen[4] stated, "The number of cases in my combined tables is not very large, but they are increasing in frequency as surgeons become more and more aware of the possibilities of hepatic surgery. Concerning the novelty of the operation, the great vascularity of the liver, and the fact that the abdomen has to be opened, a mortality of 15 per cent is quite a gratifying result. After my experience, I would hardly hesitate to attack almost any hepatic tumor without regard to its size."

In those earlier days, the technic used in the removal of hepatic tumors consisted of such methods as the use of the Paqueline cautery, the employment of large strangulating through-and-through mattress sutures, the use of elastic tourniquets tied around the base of the tumor, or the mass ligation of the vessels and ducts to that part of the liver which was to be resected. Such procedures are frowned upon as applied to most other parts of the body, but some are still utilized in the surgical treatment of hepatic disease, although there is actually little improvement in technic. The present-day methods of hepatic surgical therapy remind one of the extinct methods once utilized in surgical treatment of the lungs. It is of interest to note, with regard to this, that it was not until surgeons had shown the possibility of removal of the entire lung, or parts of it, that anatomists became interested in the intrapulmonary gross anatomic picture. Once this picture had been established, the more logical individual ligation technic was advocated for pulmonary resection.

There are other similarities between the lung and the liver, as was brought out in a previous communication.[5] Embryologically, both organs arise as entodermal outpouchings from the foregut, giving rise to central tubular structures, the bronchial and biliary passageways. The vascular structures are similar in that each organ receives two sets of afferent vessels, one that may be considered primarily nutritive (the bronchial and hepatic arter-

From the Price Diagnostic Clinic, Philadelphia.

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ies), and one that may be considered as primarily functional (the pulmonary artery and the portal vein). Likewise, each organ possesses a single set of efferent vessels (the pulmonary and hepatic veins).

Anatomists and surgeons alike have observed that there is a segmental distribution of the bronchi, the bronchial arteries and the pulmonary artery in the lung. From an examination of 150 liver casts made by the injection-corrosion technic with the assistance of Drs. Schroy and Sorensen,[5] we have concluded that there is likewise a segmental distribution of the bile ducts, the hepatic artery and the portal vein in the liver. We feel justified in including the portal vein even though we have not statistically analyzed this structure in all our cast specimens. The portal vein has been the subject of numerous investigations, especially those of Rex,[3] Melnikoff,[6] Hjortsjö[7] and Elias and Petty.[8] From their illustrations and descriptions and from our observation of the limited number of casts (25) in which the portal vein remained intact after handling during the examination of the other systems, it is obvious that the portal vein follows a segmental distribution. We can add little to their results except our own terminology

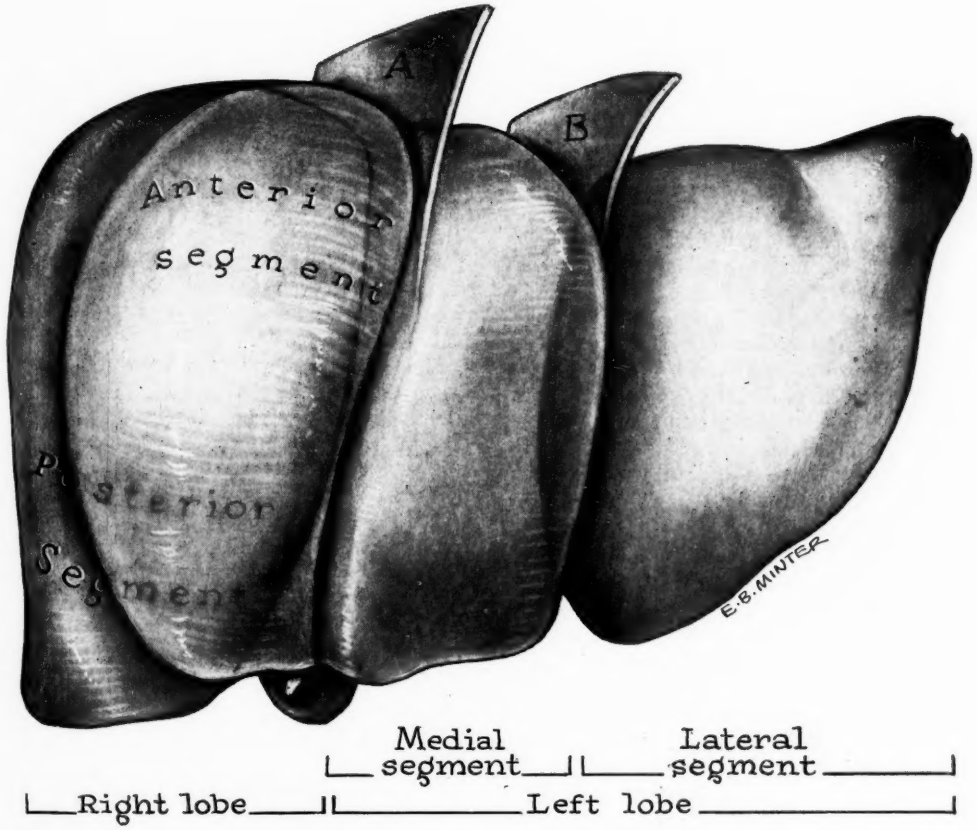

Fig. 1.—Diagrammatic illustration of the divisions of the liver, based upon the intrahepatic distribution of the segmentally arranged structures; i.e., the bile ducts, hepatic artery and portal vein. *A*, lobar fissure; *B*, left segmental fissure. The right segmental fissure divides the right lobe into an anterior and a posterior segment.

with regard to the branchings of the portal vein. In the lung, the main trunks of the pulmonary veins are not segmentally distributed in their course but mainly lie in the intersegmental planes; likewise, in the liver, the large hepatic veins follow an intersegmental course.

Divisions of the Liver—In those liver casts in which the segmentally distributed structures were injected, i.e., the bile ducts, the hepatic artery and the portal vein, one can distinguish a distinct fissure dividing the liver into its true right and left lobes. We called this fissure the "lobar fissure" (Fig. 1). On the visceral surface of the liver it corresponds to a line drawn through the gallbladder fossa below to the fossa of the inferior vena cava above. This is in contrast to the usual lobar division of the liver given in current texts. A second fissure, the right segmental fissure, can be observed in the right lobe, dividing this lobe into an anterior and a posterior segment. The left lobe was also divided by a fissure, the left segmental fissure, into a medial and a lateral segment; the latter corresponds to the left lobe as customarily used in gross descriptions of the liver (Fig. 1). Each of these four segments is further divided, according to its biliary drainage and vascular supply, into a superior and an inferior area or subsegment. The following section is a description of the prevailing pattern of branching of the vascular and biliary channels in the human liver.

Prevailing Pattern of the Right Lobe—1. *Bile Ducts* (Fig. 2): Two main ducts drain the right lobe. One of these, which we called the anterior segment duct, drains the region of the anterior segment; the other main duct drained the posterior segment, (posterior segment duct). Each of these segmental ducts was formed by the duct draining the superior area and the duct draining the inferior area of their respective segments. The two segmental ducts extend toward the porta hepatis, where they join to form a short right hepatic duct.

2. *Hepatic Artery* (Fig. 2): The right lobe is supplied exclusively by the right hepatic artery. In most of the casts (87 per cent), after arising from the common hepatic artery, it passes behind the common hepatic duct, and, just before it enters the hepatic parenchyma the right hepatic artery divides into an anterior and a posterior segment artery. Within the liver, these segment arteries join their respective bile ducts and terminate by dividing into superior and inferior area branches.

3. *Portal Vein* (Fig. 3): The right branch of the main portal trunk, like the duct and artery of this lobe, divides into an anterior and a posterior segment vein, and these in turn divide into superior and inferior branches.

Prevailing Pattern in the Left Lobe—1. *Bile Ducts* (Fig. 2): In the left lobe we also observed two main segment ducts. One of these drains the lateral segment of the left lobe (left lobe in the usual anatomic descriptions). This lateral segment duct is formed by union of the superior and inferior ducts of that segment; the union of the two ducts usually occurs in line with the fissure between the medial and lateral segments, i.e., the left segmental fissures.

The superior and inferior ducts of the medical segment coalesce to form a single medial segment duct. The latter joins the lateral segment duct to form the left hepatic duct.

2. *Hepatic Artery* (Fig. 2): The left hepatic artery arises as a terminal branch of the common hepatic and ascends obliquely upward and to the left in the porta for a short distance, then divides into a medial and a lateral segment artery. The medial segment artery descends into its segment and divides into superior and inferior area branches. The lateral segment artery extends to the fissure between the medial and lateral segments, where it divides into a superior and an inferior area branch.

3. *Portal Vein* (Fig. 3): The distribution of the left portal vein is somewhat different from that of the bile ducts and hepatic artery to this lobe. There are two

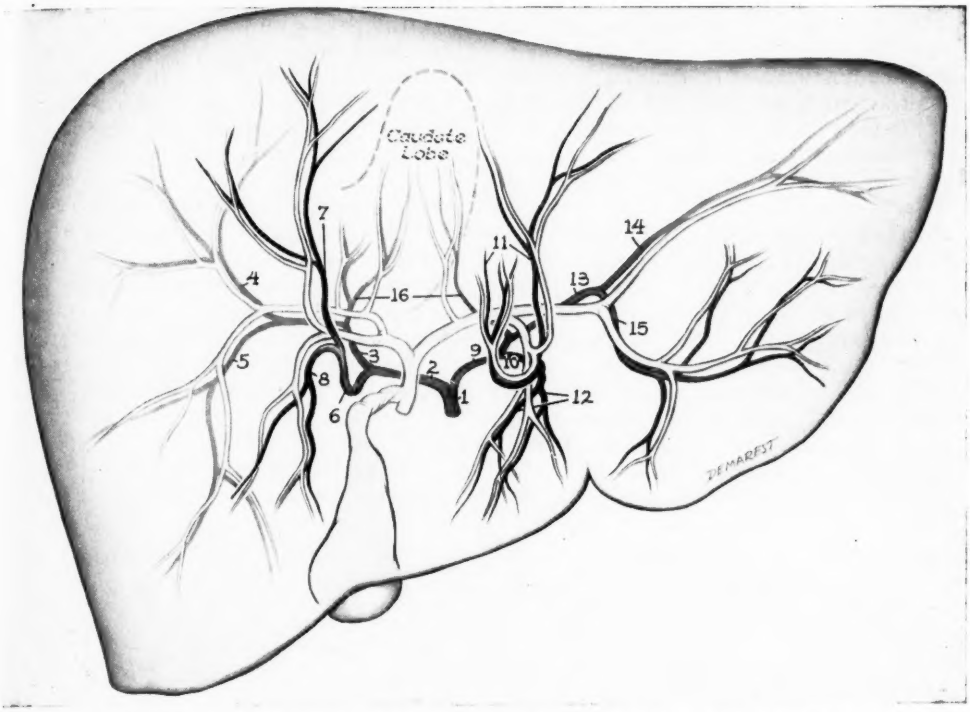

Fig. 2.—Composite drawing illustrating the prevailing pattern of branching of the bile ducts (*light*) and hepatic artery (*dark*). Although only the arteries are numerically indicated, the accompanying ducts carry a similar terminology. *1*, common hepatic artery; *2*, right hepatic artery; *3*, posterior segment artery; *4*, posterior-superior area artery; *5*, posterior-inferior area artery; *6*, anterior segment artery; *7*, anterior-superior area artery; *8*, anterior-inferior area artery; *9*, left hepatic artery; *10*, medial segment artery; *11*, medial-superior area arteries; *12*, medial inferior area arteries; *13*, lateral segment artery; *14*, lateral-superior area artery; *15*, lateral-inferior area artery; *16*, caudate lobe arteries.

parts of the left portal vein, as was emphasized by Elias and Petty,[8] a pars transversus, which lies in the hilus of the liver, and a pars umbilicus, which lies in the umbilical fossa.

In most instances there are two portal branches to the lateral segment. The vein to the superior area arises from the left side of the bend of the left portal vein as it descends into the umbilical fossa; the vein to the inferior area arises from the left side of the pars umbilicus.

The veins to the medial segment arise from the right side of the umbilical portion of the left portal vein. Usually these veins are multiple, from two to four being present. In most instances the two superior area veins and the two inferior area veins arise from common venous trunks.

Prevailing Pattern in the Caudate Lobe—1. *Bile Ducts* (Fig. 2): In accordance with its biliary drainage, the caudate lobe may be divided into a caudate process and a caudate lobe proper, the latter in turn being divided into a right and a left portion. Usually three ducts, one from each of the aforementioned parts, drain this lobe and empty into both the right and left hepatic duct systems.

2. *Hepatic Artery* (Fig. 2): The arteries to this lobe are more variable; from one to four branches are present. Predomi-

nantly, however, two arteries supply the lobe. The branch to the caudate process and the right portion of the caudate lobe proper arises as a common trunk from the right hepatic branches; the branch to the left portion of the caudate lobe proper takes its origin from the left hepatic artery.

3. *Portal Vein* (Fig. 3): The portal vein branches, like the ducts, usually number three. The branch to the caudate process arises from the right main trunk, and the two branches to the caudate lobe proper from the left main trunk.

Prevailing Pattern of the Hepatic Venous System—As has been mentioned, the hepatic veins are not segmentally distributed as are the branches of the bile ducts, the hepatic artery and the portal vein; instead, they lie in intersegmental planes and drain adjacent segments. If one observes a cast in which the portal vein, the hepatic artery and the bile ducts are injected, the aforementioned fissures are clearly visible, but, if one observes a cast in which the hepatic veins are injected as well, one cannot distinguish these fissures, for the main trunks of the hepatic veins lie in the fissured areas.

Three main trunks of the hepatic veins may be distinguished; a middle hepatic vein, which lies in the lobar fissure; a left hepatic vein, which lies in the upper portion of the left segmental fissure, and a right hepatic vein, which lies in the right segmental fissure (Fig. 4).

Each of the three trunks drains the adjacent segments. The left hepatic vein

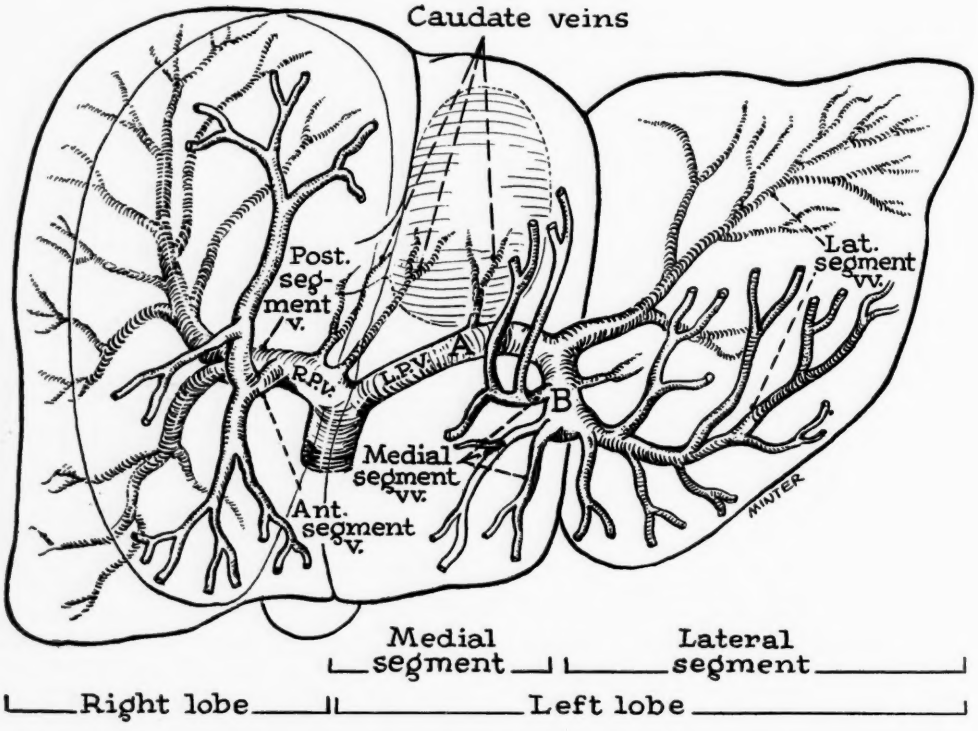

Fig. 3.—Intrahepatic distribution of the portal vein. *RPV*, right portal trunk; *LPV*, left portal trunk; *A*, pars transversus of left portal trunk; *B*, pars umbilicus of left portal trunk.

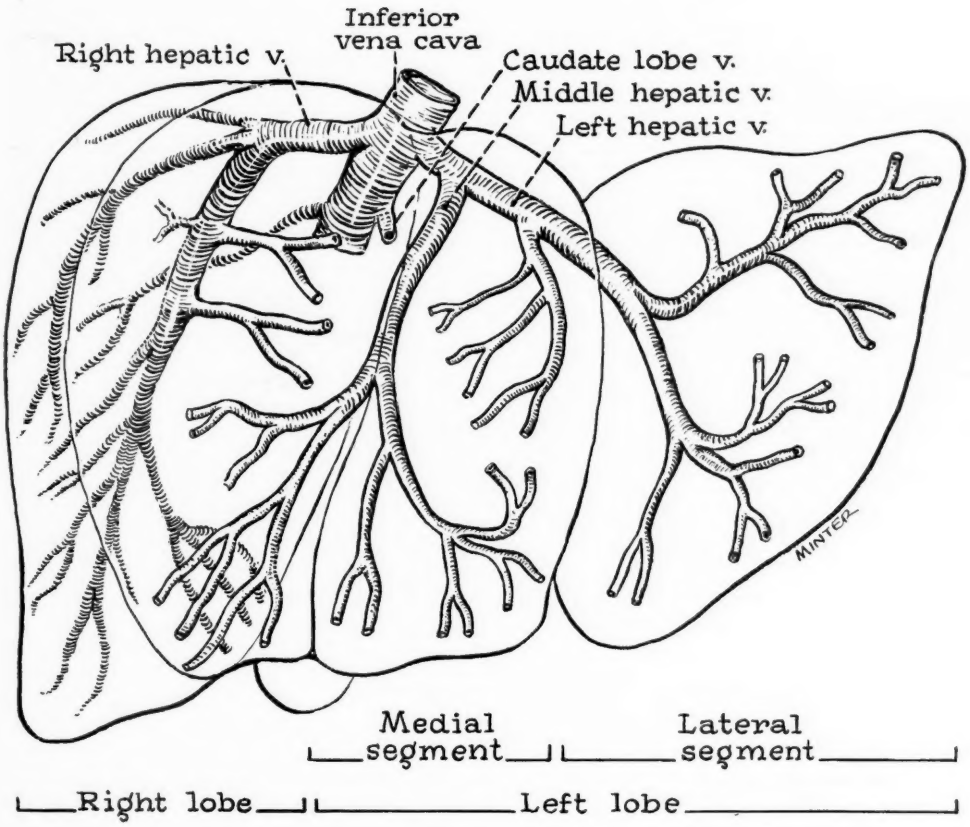

Fig. 4.—Prevailing pattern of the hepatic veins in the human liver (see text).

drains the entire lateral segment and the superior area of the medial segment. The right hepatic vein drains the entire posterior segment, plus the superior area of the anterior segment, and while the middle hepatic vein drains the inferior area of the medial segment and the inferior area of the anterior segment.

The right hepatic vein drains directly into the right side of the inferior vena cava where the latter lies in its fossa on the posterior surface of the liver. The middle and left hepatic veins, in the majority of cases, join to form a short common trunk, which enters the left side of the inferior vena cava at about the same level as the hepatic vein of the right side.

In addition to these main branches there are usually others that empty directly into the inferior vena cava. They include one or two constant branches that drain the caudate lobe, as well as inconstant branches that drain part of the posterior segment of the right lobe.

COMMENT

Naturally, many variations are encountered with regard to the vessels and ducts within the liver, the discussion of which is beyond the scope of this presentation. These data do illustrate, however, the fact

that there is a prevailing pattern to the branchings of the vascular and biliary systems within the liver. It establishes a norm, and from this norm one may identify variant patterns.

With the knowledge of the intrahepatic branchings of the vascular and biliary channels, especially their segmental and intersegmental arrangement, hepatic resection may be approached with a brighter outlook. At present, owing to the unsatisfactory methods of hepatic hemostasis, many surgeons refuse to attempt eradication of a primary or secondary tumor, even though it may prolong or save the life of a patient. After individual ligation of the blood vessels and bile ducts to the segment or lobe to be resected, it seems logical to expect that one may resect through a relatively avascular interlobar or intersegmental plane. This has already been shown possible in the dog in the work of DeWeese and Lewis,[9] and also in man as demonstrated by Ravens[10] and Quattlebaum.[11] In fact, as early as 1888, Langenbuch[12] advised that incision for removal of the left lobe (restricted sense) be made in line with the falciform ligament, for in this plane one encounters much less bleeding. This plane is actually intersegmental, i.e. it lies through the left segmental fissure aforedescribed.

A partial resection of the liver based on sound surgical anatomic principles is certainly the most logical approach in the treatment of hepatic tumors—resection of an entire lobe, a segment or an area. Questions will undoubtedly arise similar to those heard when segmental resection of the lung was first advocated.

First would be the question as to how one can identify these divisions and subdivisions on the surface of the liver. In the lung, there are surface fissures that may mark off the lobes and at times the segments. One also finds fissures on the surface of the liver, especially on the visceral surface, which, if present, seem to mark off these segments or areas. I have not sufficiently analyzed these, however, to make any definite statement. In segmental resection of the lung, the intersegmental pulmonary vein is followed in order to identify the cleavage plane between segments; and, since the hepatic veins are also intersegmental, it is possible that these vessels may be utilized for the same purpose.

SUMMARY

Although radical operations upon the liver were performed as early as 1886, little advancement has been made in the surgical technic of such resections. This is due mainly to the fact that surgeons (and anatomists) have been totally unaware of the intrahepatic course and distribution of the larger vascular and biliary channels and that, therefore, incisions through the hepatic parenchyma have been performed somewhat blindly. It is not surprising, therefore, that the present-day mortality rate for partial hepatectomies[14] is little changed from the mortality rate for similar procedures in 1897.[4]

It is the purpose of this presentation to emphasize the hope that, with the establishment of a prevailing intrahepatic gross anatomic pattern, radical operations on the liver may be performed on a more sound surgical-anatomic basis; i.e., by means of the individual ligation technic, thereby increasing operability and lowering the mortality rate associated with such procedures.

ZUSAMMENFASSUNG

Obgleich schon im Jahre 1886 radikale Leberoperationen ausgeführt wurden, sind die Fortschritte in der chirurgischen Technik bei solchen Resektionen gering. Das liegt vor allem darn, dass die Chirurgen (und Anatomen) mit dem Verlauf und der Verteilung der grossen Blutgefässe und Gallengänge innerhalb der Leber völlig unvertraut sind, und dass infolgedessen Schnitte durch das Leberparenchym einen verhältnismässig blinden Vorgang darstellen. Es kann daher nicht überraschen, dass die heutige Sterblichkeit bei partiellen Leberresektionen sich von der aus dem Jahre 1897 bei ähnlichen Ein-

griffen wenig unterscheidet.

Die vorliegende Arbeit macht es sich zur Aufgabe, die Hoffnung zu erwecken, dass mit der Aufstellung eines vorherrschenden grob anatomischen Gefässmusters in der Leber radikale Eingriffe an der Leber auf Grund einer solideren chirurgisch-anatomischcen Basis ausgeführt werden können, d.h. mit Hilfe einer individuellen Unterbindungstechnik, und dass sich auf diese Weise die Operabilität erhöhen und die mit dem Eingriff verbundene Sterblichkeit herabsetzen lässt.

RESUMEN

Aun cuando desde 1886 se han realizado operaciones radicales en el hígado, se han hecho pocos progresos en la técnica quirúrgica de las resecciones hepáticas, lo cual se debe principalmente, al hecho de que los cirujanos y anatomistas han pasado completamente desapercibido el curso intrahepático y distribución de los vasos sanguíneos y conductos biliares y por lo tanto, las incisiones hepáticas han sido bastante ciegas. Como consecuencia, no es sorprendente el encontrar que la mortalidad actual de la hepatectomía parcial[14] casi no a cambiado de la obtendida por procedimientos semejantes en 1897.[4]

Es el propósito de esta comunicación el señalar la esperanza de que, con el establecimiento de tipos de anatomía intrahepática, puedan llevarse a cabo operaciones sobre el hígado de acuerdo a una base más anatómica y quirúrgica, es decir, por medio de una técnica de ligaduras individuales, aumentando por ende la operabilidad y reduciendo el grado de mortalidad asociado a tales procedimientos.

SUMARIO

Embora operações radicais do fígado tenham sido realizadas desde há muito tempo (1886), pouco progresso tem sido feito na técnica cirúrgica de tais ressecções. Isto é devido principalmente ao fato de que cirurgiões e anatomistas não tem tido conhecimento do trajeto e distribuição intrahepática dos canais biliares e vasculares maiores e que, portanto, incisões através do parênquima hepático têm sido mais ou menos cegas em sua realização. Como conseqüência, não é surpreendente constatar que a mortalidade atual das hepatectomias parciais não é muito diversa da mortalidade de processos semelhantes em 1897.

A finalidade desta apresentação é frizar a esperança de que, com o estabelecimento de padrão anatômico macroscópico intrahepático, predominante, as operações radicais do fígado possam ser realizadas numa base anátomocirúrgica mais perfeita, i.e., por meio da técnica individual de ligadura, aumentando assim a operabilidade e diminuindo a mortalidade associada a tais processos.

RIASSUNTO

I primi interventi radicali sul fegato risalgono al 1886, ma ben scarsi progressi si sono fatti da allora, sopratutto per il fatto che chirurghi e anatomici non si sono mai resi conto della distribuzione intraepatica dei rami arteriosi e biliari, cosicchè le resezioni di parenchima sono sempre state fatte alla cieca. Non ci si deve, dunque, meravigliare se la mortalità attuale delle epatectomie parziali è poco diversa da quella che si aveva nel 1897. Vi è da augurarsi che con lo studio anatomico della vascolarizzazione intraepatica si potranno compiere gli intervento sul fegato con criteri anatomochirurgici solidi, e usando il metodo delle legature frazionate. Cresceranno, in tal modo, le possibilità chirurgiche e diminuirà la mortalità operatoria.

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To Lister and his followers the world was full of germs that must be attacked—in the air round the operation, on the instruments, hands, and clothing of the surgeon, in the operation field, and in the wound discharges afterwards. All germs were much alike, and except for a few striking examples like the bacilli of tetanus and anthrax the specific organisms responsible for infections of different types were not identified. Attention was concentrated upon killing the bacteria, and little was known of the defences of the tissues. Nevertheless, by such a simple faith, and by such crude methods as the carbolic spray, a revolution was effected that has probably never been paralleled in the realm of human endeavour. Wound fever and gangrene disappeared from the hospitals; childbirth was no longer an ordeal to be dreaded; compound fractures, which had formerly ended in death or amputation, united nearly as readily as simple ones.

With the fear of infection abolished, the way lay open to the exploration of all parts of the body and the addition of a third method, reconstruction, to the two standard procedures of surgery, drainage and excision. Surgeons were quick to embrace the opportunities thus presented to them. Before Lister, operations had been limited to the drainage of abscesses, amputations, the removal of stones from the bladder, and the excision of surface tumours. Within fifty years of his first tentative demonstrations every cavity had been explored, nearly every operation that is known to-day had been performed or projected, and countless diseases formerly hopeless had been brought within the range of curative surgery.

—Ogilvie

Cardiopericardiopexy in the Surgical Treatment of Myocardial Ischemia

The Operation and Its Results

SAMUEL A. THOMPSON, M.D., F.A.C.S., F.I.C.S.
AND
LEVON A. AKOPIANTZ, M.D., F.I.C.S.
NEW YORK CITY, NEW YORK

THE past two decades have witnessed startling developments in the scope of surgery, and the advances realized in cardiac surgery have been notable. Many have contributed to the surgical refinements attained in the various operative procedures advocated to reestablish adequate myocardial circulation, and these many approaches may be grouped into four surgical tenets: (1) the grafting of a vascular tissue to the myocardium (omentum,[1] lung,[2] skeletal muscle, mediastinal fat and spleen[3]); (2) arterialization of the coronary veins, as channels to increase oxygenation, by means of a vascular anastomosis;[4] (3) implantation of the internal mammary artery into the ventricular myocardium,[5] and (4) creation of a benign, permanent and chronic granuloma[6] between the visceral and parietal layers of the pericardium.[7] It is into the last-mentioned category that cardiopericardiopexy falls, and this paper is confined to a description of the procedure and a brief recital of its results.

A surgical operation for the relief of any physical disorder attains recognition and assumes therapeutic worth only after it has passed through a period of analysis and comparison. The relative simplicity or comparative complexity of the procedure, the various postoperative problems and sequalae that may complicate or hinder recovery, and the benefits derived from the operation must be known and equated against equivalent factors encountered in other medical or surgical procedures for the treatment of that same disorder. It is only after conformity with such an exacting formula that any form of surgical treatment can receive the stamp of endorsement.

What is cardiopericardiopexy, and how simple or complex is its execution? Of all the surgical procedures advocated for the treatment of diseases that have their basis in myocardial ischemia, cardiopericardiopexy is unquestionably the most modest in concept and the simplest to perform. The operation can be completed in thirty minutes or less. It is not necessary to open the pleural cavity. No intricate, time-consuming anastomosis, always involving the possibility of thrombosis, is required. It is a one-stage procedure. It does not demand special skills or talents other than those possessed by any well-trained and experienced general surgeon who is familiar with the anatomic and physiologic nature of the heart and the mediastinal structures. Incisions are not extensive and are not carried through heavy muscles rich with blood.

The operation of cardiopericardiopexy,[8] as performed, may be illustrated best as taking place in three steps (see illustra-

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tions *A*, *B* and *C*), as follows:

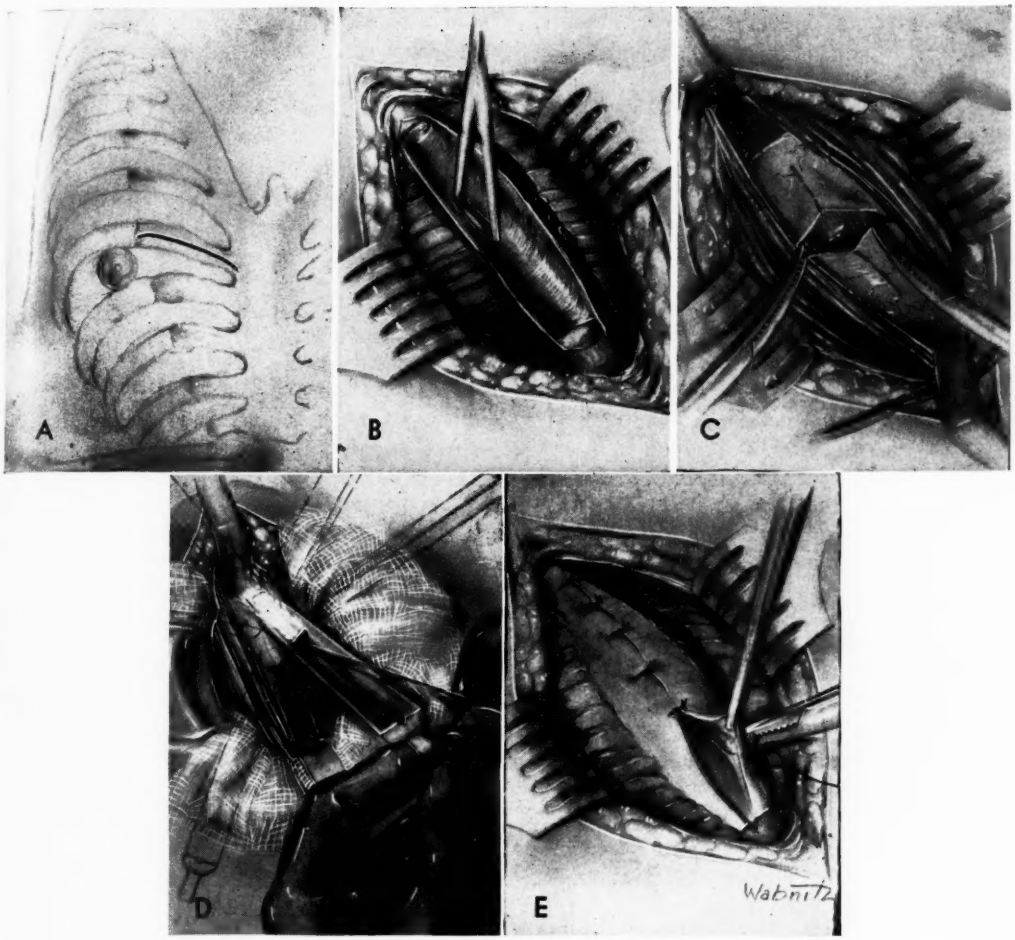
Step 1 (*A*) includes positioning of the patient, incision of the skin, and exposure and excision of the costal cartilage.

The patient is placed in the supine position. Beginning at the sternal border, a small cutaneous incision is made over the left fifth costal cartilage and is carried laterally along this cartilage to a length of approximately 7 or 8 cm. The incision is deepened carefully and carried down through the pectoralis muscles to expose the cartilage. The loss of blood is negligible. To remove a segment of cartilage, the perichondrium should be incised and stripped anteriorly and posteriorly. Some difficulty may be encountered in stripping the perichondrium from the cartilage, but whenever possible the perichondrium should be left intact. A 5 cm. segment of the cartilage is removed flush with the sternal border.

Step 2 (*B*) exposes the anterior mediastinum, including the pericardium. The posterior perichondrium is incised to a length of approximately 5 cm. This exposes a thin muscle layer, the transversus sterni, lying just deep to the posterior perichondrium, and these muscle fibers are separated by blunt dissection. The anterior mediastinum is a potentially "free" space, and the left pleura does not usually intrude into the field. When it does, it can be identified as a thin mass of soft tissue that bulges with each respiration, and it can be gently retracted laterally to obtain free exposure of the pericardium. The internal mammary vessels should be preserved, and they are retracted mesially.

In Step 3 (*C*) the pericardium is opened, the sac is explored, talcum powder is introduced and the surgical wound is closed. The pericardium is picked up carefully with two hemostats and an incision 2 to 3 cm. long, parallel to the skin incision, is made in an avascular area. Small retractors are placed at each end of the wound to elevate the pericardium and the chest wall. All pericardial fluid should b aspirated completely by means of a sma rubber catheter. To explore the heart, th surgeon's index finger may be inserted in to the pericardial sac; thus the presenc of any infarcts or scars and the existenc of any adhesions between the heart an the sac are noted. A special cannula i used to spread 2 to 4 drams (by volume of sterile dry magnesium silicate powde (USP Talc) over the anterior surface o the heart and around its borders. Instea of the cannula, a coarse atomizer may b used to disseminate the dry powder ove the surface of the heart. The pericardiu is closed incompletely with fine catgut su tures. The perichondrium is then approxi mated. The incised muscles, connective tissue and skin are sutured together, laye by layer, without drainage.

What are the postoperative problems? Shock arising from prolonged exposure and excessive handling of vital tissues and organs is never experienced. Although the problems encountered after the operation are unusual and peculiar to this procedure, they are almost always limited in number, extent and gravity and seldom terminate in death. These special problems may be grouped into those due to operative trauma, those due to foreign body reaction, and those due to the diseased condition of the heart. Postoperative pain is, on the whole, a minor complication; it is neither severe nor prolonged, persisting only for a few days, and may be controlled by the administration of sedatives and analgesics. The foreign body reaction, which is invoked by the talc introduced into the pericardial sac, reflects itself in a rise of temperature and involves the lungs, pleura, heart, pericardium and mediastinum. None of these complications is of sufficient gravity to endanger life. The temperature begins to rise from the first operative day, reaching an elevation often as high as 104 F. by



A, and *B*, cutaneous incision and excision of cartilage. *A*, position of patient and site and extent of cutaneous incision. *B*, incision carried down through pectoralis muscles to level of costal cartilage. The fifth cartilage has been stripped of its perichondrium and the cartilage removed. The posterior perichondrium is being split to expose transversus sterni fibers, and beyond these fibers lie the anterior mediastinum and the pericardium. *C*, opening of the pericardium. Pericardium exposed; small finger retractors placed at either end of incision are used to elevate chest wall and pericardium. An avascular area of the pericardium has been grasped with hemostats and incised. The pericardial incision is enlarged in a direction parallel to that of the cutaneous incision. *D*, introduction of talc. With the pericardium opened, the pericardial sac is aspirated dry by means of a small rubber catheter. Moist gauge pads and packs are placed about the wound to protect exposed tissues from excess talc, and finger retractors are elevated to enlarge the operative area. The drawing illustrates the introduction of talcum powder, a specially constructed cannula being used to disseminate the powder in all directions around the myocardium. *E*, closure. The perichondrium and muscle and the connective tissues of the chest wall are closed in anatomic layers without drainage. The skin is approximated with silk.

the second or third day. It subsides gradually. The entire febrile course lasts less than ten days; rarely, it may persist as long as two weeks. The lungs and pleura are almost always involved. Fluid may form in the pleural cavity on the seventh to the tenth day in small amounts but rarely requires aspiration. Pulmonary consolidation of the left lower lobe begins after the first postoperative day. Pathologically, this is a form of interstitial pneumonitis, and there is no expectoration and no evidence of moisture in the alveoli. Striking bronchial breath sounds and a clear, high-pitched expiration may be heard best in the left axilla and below the angle of the left scapula. The patient does not appear ill and is not dyspneic or cyanotic. The mediastinitis, which makes its appearance from the first postoperative day, is demonstrable roentgenographically by bulging mediastinal outlines. The inflammation gradually resolves, but it may persist in mild form for several weeks. Although extensive adhesions form between the myocardium and the pericardium, the pericarditis is not of the constrictive variety and has never been known to constrict, distort or impede the heart. In fact, the adhesive granulomatous pericarditis established is a benign, beneficial and permanent sequela, which is directly responsible for the increase and maintenance of myocardial vascularity. A pericardial friction rub can be heard over the entire precordium, from the second to approximately the seventh day. Electrocardiographic changes characteristic of acute pericardial reaction appear within a few hours after the operation and persist for as long as several weeks. These changes include a downward shifting of the S-T segment of Lead III and a concordant shift in the R-S-T segment in the limb leads. Since none of these patients have normal electrocardiograms before the operation, the postoperative electrocardiogram can never be expected to return to a pattern closer to normal than its preoperative composition.

By far the most important of the complications that follow cardiopericardiopexy are those which arise because of the diseased state of the heart. Although extrasystoles may develop frequently during the operation, they are encountered only occasionally thereafter. Undoubtedly the most serious problem is coronary occlusion. The problem may take two forms. Despite every effort to prevent the patients from coming to operation with unrecognized but active infarction, 6 deaths in a total of 85 patients operated on were attributed to active infarction present but unrecognized at the time of the operation. Two of these patients died within forty-eight hours after the operation and 1 within a week, from rupture of an unhealed infarct. Several patients have had attacks of coronary occlusion subsequent to the operation, and 3 of these have died as a result of the process. Those patients who survived the operation for two months or more have weathered subsequent attacks of coronary occlusion, and only 1 of these died, a "sudden coronary death." Passive congestive heart failure occurring from one to seven years after the operation accounted for 6 deaths; nevertheless, it is a clinical impression that the operation prolonged the lives of these patients by delaying the onset of terminal congestive failure.

What are the benefits[9] derived from cardiopericardiopexy? Clinical improvement is statistically significant. In a fifteen-year study of patients who had undergone cardiopericardiopexy, 90 per cent were improved more than 50 per cent, and 40 per cent were improved more than 75 per cent, as shown by decrease in anginal pain, increase in exercise tolerance and improvement in ability to attend to their daily needs and return to a former or some other gainful occupation. In addition to

this physical improvement, the patients who died after undergoing surgical treatment lived for an average five years, which gives them an average life span of nine and one-half years from the onset of the first symptom. This compares favorably with the average life span of four and one-half years (from the onset of the first symptom) of the patient treated medically for coronary disease. Statistically, cardiopericardiopexy contributed five years to the life of the average patient who underwent the operation.

These are advantages that cannot be contemptuously or presumptuously thrust aside.

SUMMARY

The advantages and postoperative issues of cardiopericardiopexy as a method of surgical treatment for myocardial ischemia are recounted, and the operation is described and illustrated.

SUMARIO

As vantagens da cardiopericardiopexia como método de tratamento cirúrgico da isquemia do miocárdio são relatadas, e a operação é descrita e ilustrada.

RÉSUMÉ

Les avantages et les résultats postopératoires de la cardio-péricardiopexie en tant que méthode de traitement chirurgical de l'ischémie myocardique sont exposés; l'opération est décrite et illustrée.

ZUSAMMENFASSUNG

Die Vorzüge und die postoperativen Probleme der Kardioperikardiopexie bei der chirurgischen Behandlung der Ischaemie des Herzmuskels werden erörtert. Die Arbeit enthält eine Beschreibung der Operation mit Illustrationen.

RESUMEN

Se revisan las ventajas y resultados postoperatorios de la cardiopericardiopexia como método de tratamiento quirúrgico de la isquemia del miocardio describiéndose e ilustrándose la operación.

RIASSUNTO

Vengono elencati i vantaggi ed i risultati della cardio-pericardiopessia nella cura dell'ischemia miocardica; viene pure descritto e illustrato l'intervento.

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We go to the gymnasium and the swimming-school to see the power and beauty of the body; there is the like pleasure and a higher benefit from witnessing intellectual feats of all kinds; as feats of memory, of mathematical combination, great power of abstraction, the transmutings of the imagination, even versatility and concentration—as these acts expose the invisible organs and members of the mind, which respond, member for member, to the parts of the body. For we thus enter a new gymnasium, and learn to choose men by their truest marks, taught, with Plato, "to choose those who can, without aid from the eyes or any other sense, proceed to truth and to being."

—Emerson

The Evolution of Anesthesiology in Brain Surgery

G. LAZORTHES, M.D., F.I.C.S., and L. CAMPAN, M.D.

TOULOUSE, FRANCE

ANESTHESIOLOGY in brain surgery has labored under many difficulties, not only in the choice of narcosis-producing agents but in reanimation procedures. At first, general anesthesia alone was used. Toward 1910, local anesthesia, proposed by Cushing in the United States and by de Martel in France, became an asserted dogma. Nowadays, it seems, narcosis is coming to the front again. The tendency of preoperative, postoperative and operative anesthetic therapeutics has undergone notable variations, but has now taken advantage of important new discoveries resulting in equally important progress.

The first neurosurgeons relied on general anesthesia. Most of the volatile anesthetic agents were tried. Chloroform, first used by Horsley (1906), Hartley and Kenion (1907) and Krause (1910) was soon recognized as depressive and hypotensive (Kocher); its risks soon appeared as still greater than those encountered in general surgery; it was given up. Ether, less dangerous, was then adopted by most surgeons, although its main drawback, the tendency to bleeding, has been recognized (Horsley). Ethyl chloride then appeared to some, Cushing among them, as a good starter anesthetic.

The only prenarcotic then known was morphine (Bernard) used alone or in association with atropine, sparteine or scopolamine. It was first recommended by Horsley (1888) to precede the chloroform sleep, then by Kuttner and others; it was blamed for respiratory depression or for increased intracranial hypertension. Kocher (1899) and Krause (1910) warned against its systematic use.

The risks were considerably increased by the crude and unsafe conditions under which narcosis was obtained: compresses or masks were employed immediately next to the operative field, in the most unsuitable positions; the duration of narcosis was always excessive, and assistants were entirely under the control of the surgeon, who could give them only scant attention. On the whole, it was a dangerous practice.

This explains the favorable welcome that greeted the appearance of local anesthesia. The precursors of this new method were Heidenheim (1904), who injected epinephrinized cocaine under the galea, and Brun (1904), who inaugurated epinephrinized procaine hydrochloride. The real promoters prior to the 1914 war were de Martel and Cushing, who, dissatisfied with general anesthetics, adopted local anesthesia as a regular practice.

The advantages of local anesthesia cannot be doubted. It has none of the former drawbacks of narcosis, and remains devoid of toxicity whatever dose is required, since it causes loss of sensitivity only during the operative maneuvers known to be really painful, namely, those affecting the superficial organs. It enables the surgeon to maintain contact with the patient during the operation (except when loss of consciousness occurs) and thus to judge his condition easily.

Its drawbacks are no less certain; the

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chief one is insufficiency. It insures painless incision of the scalp but does not induce tactile insensitivity, and the patient, should he be the least anxious or mentally confused, loses control of himself, moves his head and displaces the guiding marks. When it is time to close, the effect of the anesthesia has more or less vanished; the patient again suffers, and moves still more dangerously, just at the time when absolute calm is desired.

It cannot be positively stated that intracranial procedures are absolutely painless. Although the cerebral parenchyma has no sensitivity, certain structures in the head are susceptible to pain, such as the median meningeal artery (twitchings, especially at the hinge of the temporal flaps), the falx cerebir, the tentorium cerebelli, the meninges, the cranial basis vessels and the sensory cranial nerves (ninth and tenth). Besides, local anesthesia does not suppress the unpleasant perception of noises, vibrations and discomfort, and it leaves intact the subjective impressions of the patient; it submits him to an endurance test often beyond his strength, and its dangers as regards the vegetative system cannot be underestimated. Lastly, it does not prevent epileptic fits, vomiting and cough, nor does it insure free passage of air in case of obstructive or depressive accident.

Attempts have been made to palliate the shortcomings of local anesthesia by a preparatory potent basal anesthesia involving rectal chloral, intramuscular slow action barbiturates and more frequently opiates—morphine, total opium, heroin (Hunter), dihydro-morphinone, dihydro-oxycodeinone, pethidine, etc.—in association with classic vagolytics and correctors. Opiates, generally excellent in most cases, call for criticism: their depressive and cranial hypotensive effects had already been pointed out by several authors. Some considered chloral and the barbiturates preferable. Any basic anesthesia always offers the unassessable risk of being either excessive or insufficient. In this last case it may, paradoxically, increase the restlessness of the patient by abolition of his self-control. Often the association of basic anesthesia and local anesthesia fails; it is then necessary to renew the doses of the opiate under adverse circumstances, with the danger of overdosing and even of having to improvise, under the worst conditions, some type of general anesthesia, e.g., intravenous.

Notwithstanding justified criticisms, local anesthesia has established itself as a marked improvement over the older methods. It has uncontested services and has been contemporaneous of a great neurosurgical period; many neurosurgeons have remained its devotees.

An important event marks the present period. It is the coming to the front of physicians specializing in neurosurgical anesthesia. Their presence during the operation had for some time been usual in the United States, where their principal reason for being was to act eventually as reanimators, while in England they acted as anesthesists. It is only more recently that they have entered the picture in France, where they have been able to introduce and adapt new anesthetic and reanimating procedures especially suitable to surgical treatment of the brain.

The Principles of Anesthesia.—General anesthesia, though long supplanted by local anesthesia, never was completely abandoned, especially in England. But, to be absolutely justified, *it must satisfy four essential and imperative conditions:* 1. *It must not increase the intracranial arterial pressure.* 2. *It must not heighten the danger of hemorrhage.* 3. *It must not increase pain referable to the vegetative nervous system.* 4. *Its action must in no way interfere with the success of the operation.* To these four conditions must be added two practical necessities: *application must be remote from the operative field,*

and no explosive chemicals may be used.

a. The influence of narcosis on the endocranial arterial pressure dominates the problem of anesthesia. It is known that cranial hypertension has general causes as well as the particular effect of neoformations or their complications. Among these causes are: hydrodynamic modifications of the status of the cerebrospinal fluid; secondary venous stasis due to increase of cerebral volume; perifocal edema, and active generalized edema due, according to J. Lebeau (1941), to irritation of the special vasomotor centers located in the brain stem. These factors may influence each other, independently of the neoformation, and are in themselves both sources and consequences of pain. They constitute a vicious circle. Aggravation of one of them, especially venous stasis (Guillaume and Jany, 1951), is capable of causing sudden decompensation of hypertensive states just barely tolerated until then. Yet, narcosis of itself creates a number of the aggravating disturbances it may introduce (Lazorthes and Campan, 1952). Any expiratory spasm (coughing, sneezing, vomiting, or expulsive efforts caused by an endotracheal probe or by tracheobronchial secretions or their aspiration); any expiratory trouble, and, in a general way, any intrathoracic suppression, either short or prolonged (controlled breathing under positive pressure), may cause venous hypertension, especially marked in the cerebral mass. A retrograde venous overload adds its effect to that of the already existing stasis, and a most dangerous increase in intracranial hypertension is created. Additionally, it has been demonstrated that phyoxy increases the cerebral volume through plasmatic exudation and that hypercapnea also increases it through capillary vasodilatation (White, Verlot, Silverstone and Beecher, 1942). As a consequence, it is clear that neurosurgical narcosis (1) *must create no increase of the positive intrathoracic pressure and no resistance to breathing, especially expiration;* (2) *must be antispasmodic, antiemetic and drying;* (3) *must allow strictly physiologic respiratory exchange, and* (4) *must preclude any postanesthetic agitation.* As a matter of fact, these exigencies are similar to those of any other surgical discipline, but in this connection they are most imperative. The preoperative increase of intracranial pressure, and, *a fortiori,* that of preexisting hypertension is dangerous for two reasons; it increases cerebral pain and creates turgescence with a tendency to evisceration, thus complicating and perhaps compromising the success of the operation. On perfect "cerebral relaxation" depends the "operative silence" necessary here as in any visceral operation.

b. The hemorrhagic danger is classic in surgical treatment of the brain. General anesthesia may increase it either through local vasodilation, through a general increase of arterial pressure or through the increase in venous tension just explained. Most of the causes that foster cerebral turgescence also foster operative or postoperative venous hemorrhage. After craniotomy the cerebral veins (nonmuscular) are more fragile than before, their internal pressure being no longer compensated by the cerebrospinal fluid pressure and the containment of the skull. The same situation results, in the closed skull, from cerebral collapse, a further reason why the narcosis must respect the exigencies aforedescribed.

c. General anesthesia may also increase the patient's vegetative pains in several ways: through intracranial hypertension, through hemorrhage and classic shock, through the toxicity of some anesthetics (liposoluble with cerebrospinal activity, depressors of breathing and of circulation). If it is not to become an additional aggression, neurosurgical narcosis must be purely *superficial, nonaggressive and atoxic for the brain.*

d. General anesthesia appears to be contraindicated only for those operations which have a functional objective, the effects of which must be immediately verified: procedures for the suppression of pain (anterolateral cordotomy), for dyskinesia (cordotomy, section-coagulation of the lenticular loop) and for epilepsy. Any strong premedication is to be prohibited.

Anesthetic Technics.—The various technical considerations just mentioned have only gradually become clear to anesthesiologists and neurosurgeons, and it has not always been possible to apply this sequence of logic with all the desirable rigidity. General and local anesthesia each have long retained their partisans. The problems discovered were but gradually solved.

Almost all the anesthesic products offered by the pharmacopoeia in the past fifty years have been tried one after the other, especially the noninhalatory type that permits application remote from the operative field. Their action on the intracranial pressure has been the subject of important studies (White, Verlot, Silverstone and Bercher, 1942; Woringer, Brogly and Schneider, 1951). A great many had to be rejected. *Ether* has the advantages of not being depressive of superficial regions and allowing normal respiratory exchange, but it presents the most severe neurosurgical drawbacks. It is a cerebral hypertensor and a venous hypertensor; it is cough-exciting, it is an emetic; it is hypersecretory; it is an explosive, a generator of postoperative excitation or depression, and is responsible for respiratory complications, themselves a secondary cause of anoxia and cough. It still has some advocates, especially in England, but its use today seems difficult to justify. *Ethyl chloride* might be permitted for short operations, but of all general anesthetics it is the most offensive intracranial and venous hypertensor and consequently must be eliminated. *Trichlorethylene,* introduced by Hewer (1941), may be retained, as it is nontoxic, indifferent as regards intracranial pressure, and nonexplosive; it also permits satisfactory exchange. Its use in open circuit, without sodic lime, is not a disadvantage. *Cyclopropane* should not be a cranial hypertensor below 50 per cent concentration, and consequently would not be such with the low concentrations required by the duration of the intracranial operation; its rapidity of induction and elimination is interesting. Its use is precluded only by its explosiveness. *Nitrogen protoxyde,* easily handled, atoxic, and nonreflexogenic, deserves a place in anesthesic cocktails. Its hypertensive effect at 80 per cent is easily corrected by any of the currently known hypotensive agents. It can, for the present, be considered the best maintenence anesthetic for the duration of an intracerebral operation (Hunter, 1947; Teplinsky, Zigmore, Cassels and Sugar, 1948).

Among rectal anesthetics, *ether,* proposed in 1929 by Frazer, has, of course, nothing more than historical interest, but *rectal chloral* is still frequently used for children; as regards *tribromethanol,* proposed by Dandy and by Sachs (1931), it has the advantage of being, in principle, indifferent as regards intracranial pressure; it may even be considered a cerebral hypotensor, in that it reduces the general arterial pressure; against this, it has the disadvantage of being depressive and of sometimes inducing an overprolonged sleep. The major argument against all rectal anesthetics is the erratic character of their action, varying from insufficiency to excess. Some authors have recommended the addition of avertine to the local anesthetic (Davidoff, 1934), to ether (Dandy, Dott) or to any other complemental product. All told, account being taken of its advantages and disadvantages, rectal anesthesia must be considered an interesting base anesthesia to be employed

as required in the individual case.

Barbiturates have been tried from the onset. *Hedonal* was used and discarded by Mennel prior to 1914. *Nembutal* was used by Dott in 1933; *Pentothal* by Miller (1942), Ascrofft (1943), Woodhall and Goodmann (1943), and they considered it the ideal neurosurgical anesthetic. Yet the barbiturate was not at all ideal when these authors began using it; it is only later that it became so. Its major quality is an incontestable cerebrohypertensive action. This action is so irregular, however, that it would not have been sufficient justification for its use if the method of its administration had not been improved. Used alone and according to the early technics, it presented numerous neurosurgical drawbacks; it caused spasm and it depressed the respiratory exchange; the irregular and erratic character of the barbiturate sleep, the variations in the narcotic value, the difficulties of narcosis control, the risk of overdosage, the postanesthesic agitation or depression. Its cerebrohypotensive action itself was dependent on unpredictable fluctuations in the anesthesia and of brutal inversions, for instance in case of coughing fits. In 1951, therefore, one could say that while pentothal fostered cerebral relations it also favored adverse secondary cerebral reactions. The results it procured could either be of the best or of the worst. Combining it with other anesthetics, such as protoxide (Hunter, 1947; Teplinsky and associates, 1948), only obviated some of its defects. A strong base anesthesia improves its efficacy but introduces drawbacks of its own.

That is why, in 1951, we adopted the *prenarcosis* recommended in France by Laborit and Huguenard for general surgery, and from which we obtained results difficult to overestimate. It covers, in fact, all neurosurgical requirements, allows correction of previous pentothal deficiencies, confirms and stabilizes the latter's hypotensive cerebral activity. It has thrown into oblivion the old basic narcosis induced by strong opiates. In our opinion, the acceptance of general anesthesia for surgical treatment of the brain is indisputably desirable.

The choice of the best anesthetic agents (barbiturate, nitrogen protoxide, trilene and lytics) is, however, not everything. The methods of administration are just as important. We have previously insisted on the value of the dilution of pentothal (easily handled, economical and nonhypotensive); on the use of diluted lytic cocktails in individual doses, with control of their hypnogenic and vegetative effects; on the advantages of *gradual loss of consciousness and awakening*, concerning which we agree with Hewer. The *limit positivity of the corneal reflex* for the whole duration of the operation is also an excellent and easily obtained evidence of safety. Local anesthesia of the scalp remains a very useful adjunct and best allows reduction of the doses of general anesthetics.

Tracheal intubation, an elementary requirement of narcosis remote from the operative field, had the advantages of excluding the obstruction accidents by which cranial operations were previously impaired; of facilitating artificial breathing in case of depressive accidents, and always of maintaining physiologic respiratory exchanges. Of course, it must also satisfy the general requirements previously explained. *Intubation and extubation must be achieved in a strictly nonreflexive manner, toleration of the probe must remain absolute throughout the duration of the operation, notwithstanding the mildness of the narcosis.* Rapid intubation assisted by pentothal-curare must be rejected, as it suppresses all reflex reaction, requires apneizing doses calling for immediate controlled respiration manipulations (undesirable, as we shall show) and contributes nothing toward ulterior toleration of the probe. This intubation

procedure would require maintenance of the narcosis to a level much deeper than that required by the cerebral procedure itself, and this is not acceptable. Consequently local *pharyngolaryngotracheal anesthesia* is necessary, provided that it does not induce any reflex action of its own. Laborit-Huguenard prenarcosis is generally sufficient to create indifference and absence of reflex, at the same time preserving the possibility of the patient's limited cooperation. When this is not the case, we have found it satisfactory to administer local pentothal, the necessary dose (0.1 to 0.2 gm.) usually being the only one necessary for the whole duration of the procedure. A carefully administered local anesthetic insures toleration of the probe for several hours. The end of the probe must remain far from the beak. Nylon probes are better tolerated than are probes made of rubber.

It has been thought necessary to simplify and lighten the anesthetic equipment to a minimum, and to use no other than the lightest apparatus with minimum resistance to air circulation—this to avoid any respiratory effort and especially any expiratory resistance that might increase the venous element of the general intracranial hypertension. For this reason, come-and-go mountings are preferable to circuit mountings, and the semiclosed system is preferable to the closed system. The use of light valves, e.g., the Digby-Leigh system, helps to solve the problem of respiratory freedom. Controlled or even simply assisted respiration is contraindicated, because it induces cranial hypertension (Watrous, Davis and Anderson, 1950), which absolutely excludes apnea-inducing or even simply depressive methods. Spontaneity and amplitude of the respiratory function must be achieved. Manual respiration with the bag, failing anything better, is acceptable only in cases of unavoidable depression or loss of consciousness. Theoretically, however, it would be preferable in such cases to employ more nearly physiologic procedures not yet in general use, like the drinker respirator of Sarmoff's electrophrenic procedure, as suggested by us in 1952.

Controlled Hypotension.—With the twofold objective of artificially decreasing the operative hemorrhage and, still more important, reducing the intracranial pressure, numerous methods of so-called "controlled hypotension" have been suggested and constitute one of the most fascinating problems of anesthesiology in recent years: spinal hypotension by spinal anesthesia (Morton, 1900; Jonnesco, 1909; Van de Walle, 1951; Van Leere and Samain, 1952), selective rachi-hypotension by 0.5 per cent hyperdiluted procaine hydrochloride, affecting no more than the sympathetic filaments (Griffith and Gillies, 1948; Greene, 1952; Swanson, Galvin and Fisher, 1951), continuous rachi-hypotension (Uinlein and Lundy, 1952), exsanguinous hypotension (Gardner, 1940; Hale, 1948; Bisland, 1951; Mortimer, 1951), associated rachi-hypotension and exsanguinous hypotension (Uinlein and Lundy, 1952), pharmacodynamic and postural hypotension (Enderby, 1950), to which may be added the method of negative venous pressure by application of cupping-cylinders around the lower limbs with attraction of the hemic mass in that sector (de Martel, 1918). Most of these methods are applied in cases of delicate patients whose condition calls for as much prudence as audacity. Pharmacodynamic and postural hypotension deserves special attention. It was advocated in France by Petit-Dutaillis, Guiot and Damoiseau (1951) and later by Woringer, Broogly, Schneider, Baumgartner and ourselves, and in Germany by Loew and others. Methioniums originally proposed may be, as now, replaced by other substances (of varying action) or associated with them: procainamide, whose innocuousness is not absolute with efficacious doses; chlorapromazine (Laborit and Hu-

guenard); Hydergine; Regitine; Arfonad, a short effect ganglioplegic (five minutes) recently proposed by Frey, and M.134, a hemorrhage moderator without deep hypotension (Kucher and Steinbereithner, 1953). And the list of usable hypotensors is surely not yet closed. So great a pharmacologic abundance ought to allow gradation of the most minute fineness in application.

Let us recall, however, that the association of a diversity of products and its application in patients whose vasomotor tonus is disturbed, and to whom other vasomotor drugs (such as Prolethazine) may have been recently administered, results in complex clinical effects either by synergy or by antagonism.

It must also be recalled that D. Tubocurarine is an agent of orthostatic hypotension (Cier and Tanche, 1953). Many of the preanesthetic and anesthetic products, such as Tribomethanol and the barbiturates, are themselves hypotensive and often permit one to obtain sufficient narcohypotension. The same can be said of hibernation. The *simple fact of operating on a seated patient*, as is done by de Martel (a method unjustly abandoned by some), has regained favor as an adjuvant of pharmacodynamic methods and is the most elementary process of cephalic exsanguination through venous depletion and even through arterial hypotension.

In short, the problem of controlled hypotension, of which neither the stumbling-blocks nor the advantages should be minimized, has undergone considerable evolution during the past three years. This general method must not be enslaved by any particular procedure or drug. The practical interest of the postural method is its mechanical reversibility. For the present the following procedure can be recommended: Place the patient in a measured seated position after narcosis or hibernation, as the case may require; obtain secondary accentuation of the hypotension by means of another ganglioplegic, this preferably after opening of the flap, as recommended by Petit-Dutaillis and Guiot (1953).

The dangers of hypotension, of which Bartorelli has recently made a general review, are increased in surgical treatment of the brain. With Anduze and Stellet, we have studied the safety indications to be observed during hypotension by the Methoniums. They are the same whatever method is used: preservation of a relatively high oscillometric index, stability of the pressure except while the hypotensive injections are in process, good brachiodural tensional dissociation and absence of modifications in the respiratory function. Ducaillar and Roger (1952) have insisted, as we do, on the respiratory alarm signals: hyperpnea, hypopnea and Cheyne-Stokes breathing. It is dangerous to try to obtain very low hypotension. It may cause severe disturbances in the irrigation of the brain and endanger the hematosis of the vegetative centers. The minimum permissible figures of course vary from one patient to another, and are diversely appreciated by authors, but a tensional drop of more than 30 per cent of the normal arterial pressure can be considered risky; any drop below 8 (average pressure) must be considered as dangerous and positively unacceptable. This, at least, is the result of our clinical observations and of the measurements of cerebral blood flow obtained by Espagno. According to this last-named author, cerebral irrigation remains remarkably stable above the critical level, but founders just below this level: its fall can then no longer be compensated by a sufficient decrease in the vascular resistance and therefore entails a deficit in the consumption of oxygen. Cerebral anoxia is the danger common to all methods (Beaconsfield). It is greater with the patient in the seated position, but is then easily corrected by timely action. Cerebral irrigation is evidently less diminished, for

an equal degree of hypotension, when the patient is in a recumbent position. If it is admitted with Bernsmeier and Siemons that intracranial hypertension itself mechanically lowers the cerebral output, then a consequent reduction of the margin of safety must be admitted. It is prudent, then, as recommended by Petit-Dutaillis and Guiot, not to begin or to reduce the hypotension further until after the flap has been opened. According to Aserman, the pressure from the retractors would be more ischemic for the vasoplegic patient (compression anemia) and might create irreversible local anoxic lesions. Inversely, hibernation would increase the resistance to ischemia through reduction of the oxygen need of the nervous tissue.

Finally, emphasis must be put on the advantages as well as the drawbacks of a series of methods that find in neurosurgery their best indications as well as their greatest dangers. We ourselves use these methods daily with precise technics, taking maximum heed of the individual factors within strict safety limits, their efficiency against turgescence and blood effusion is sufficient. It would be excessive to strive for absolute exsanguination. The ganglioplegics participate in the treatment of the postoperative cranial hypotension.

Reanimation.—When Cushing insisted, for the first time, on close observation of the postoperative fluctuations of the vegetative status of the patient, he laid the first stone of neurosurgical reanimation. In this realm, as in the others, theories have greatly progressed, and reanimation, having more and more become a prophylactic question, really deserves a change of its name. It is essential to prevent disorders before their installation, when they have not yet formed a vicious circle from which their elimination could only be more or less incomplete, and might even be prejudicial to the balance of the organism.

For a long time, efforts were concentrated on correction of collapse and/or shock mainly due to the operative hemorrhage, then frequent, the consequences of which were aggravated by the ischemia characteristic of cerebral hypertension (Bernsmeir and Siemons) as well as by the lesser resistance to aggressions of patients with central lesions (Mosinger's neurogen heterergia). Postoperative transfusion has brought elimination of hemorrhagic shock in neurosurgery, as in other operative fields. There is very little to say on that subject: massive, and sometimes even abusive, originally perfusions now are much more rational; they have become, in many cases, superfluous since the advent of the hypotensive and hibernation methods procuring prophylaxis of shock as well as its tolerance by vasomotor regulation.

Besides hemorrhage and shock, the neurosurgical patient is known to present particular vegetative disorders associated with intracranial neoformation and following the operation. The acute clinical picture of the central neurogenous syndrome is of varying intensity but sometimes dramatic. Troubles of conscience, especially vegetative (Vincent) of the thermic, tensional, cardiac, respiratory, metabolic and endocrinous regulations are encountered. The prognosis often is of the darkest. The pathogenesis simmers down to a Reilly syndrome of central origin, as serious as possible. Mosinger and G. Tardieu have both reproduced it in animals by direct traumatism of the vegetative nucleus or by intradiencephalic and peduncular injections of irritative substances. For G. and C. Tardieu the operative sequelae of these experiments have the same value as actual experimentation on human beings. There are numerous causes for vegetative irritation during the evolution of a neurosurgical illness. Prior to the operation, the neoformation has no direct influence unless it is located in the immediate vicinity of the centers, but it has an in-

direct influence, mostly through the intracranial hypertension it causes. During the operation more or less serious vegetative disorders may be observed: loss of consciousness when local anesthesia in used, sudden fall of the arterial pressure, or, on the contrary, a sudden hypertensive outburst, often concomitant with an outburst of cerebral edema, polypnea, stertor or respiratory syncope (juxtabulbar tumors), etc. The cerebral parenchyma, besides, is the most sensitive of all to surgical traumatism; its vasomotor reactions are the most immediate, the most intense and the slowest to subside. Operative acute cerebral edema takes place as suddenly as does Quincke's edema. The prognosis of postoperative sequelae is dominated by the possibility of cerebral hypertensive complications (edema, blocking by cerebrospinal fluid, secondary hemorrhage) as well as of hypotensive disorders, the danger of which is increased in the presence of controlled hypotension. The risk of vegetative irritation is of course much greater in axial or para-axial operations (diencephalic and posterior fossa) than in operations involving the convexity.

Treatment of such a syndrome has always been most difficult. In attempting to restore vegetative balance, surgeons formerly had recourse to the complete range of the mimetics and lytics then known, a slight preference being given to the former. The same errors as in the other domains were committed with the same good intentions, even to the extent of recommending intravenous epinephrine for vascular collapsus of diencephalic origin. All these empiric, symptomatic therapeutic methods were generally deceptive.

Because of the peculiar clinical picture, which gives an impression of forcing, and considering its pathogenesis, we thought in 1951 that hibernation therapy following the procedure established in France by Laborit (sleep, vegetative blocking, refrigeration) could bring the answer to our problems, not only as regards the vegetative symptoms but also in tracing their causes: stasis and cerebral edema. Its efficacy has, since then, been amply proved.

The central action of its pharmacodynamic agents is highly favorable; it prevents or reduces dangerous hyperthermy, agitation and respiratory burden, and regularizes the oxymetry of cases in which cyanosis is present. It is at so deep a level that it is really active against tachycardia. Its indications may seem questionable with regard to disturbances of consciousness; it seems illogical to treat coma by sleep, and on this point the therapist must do himself violence, even if he agrees with G. Tardieu on the irritative pathogenesis of these disturbances. Its antiemetizing and anticonvulsive actions are valuable. Its action on cerebral edema diminishes the severity of the attack.

It is possible today to affirm its many and significant indications. Preoperative hibernation therapy is capable of improving serious acute neurovegetative syndromes such as would, without this therapy, be considered as contraindicating operation on the grounds of excessive danger. It makes it possible to proceed quietly and without danger in the localizing examinations. Its major indications are procedures affecting the diencephalic region (tumors of the third ventricle, craniopharyngiomas, median, olfactive and sellar meningiomea) or the posterior fossa, especially the tumors of the fourth ventricle, which Mahoudeau has well studied. It is equally indicated for all extensive exereses of gliomas and meningiomas likely to react indirectly on the walls of the third ventricle. In cases of cranial traumatism, we have detailed elsewhere its indications and limitations.

It is mostly as a preventive that it must be used. Its preoperative induction is easily obtained, since the prelytic narcosis also is a prehibernation. Some technical points

require underlining. The drug dosage is individual and cannot be determined otherwise than extemporaneously, by control of the sleep threshold and the degree of vegetative disconnection. It may be expedient to dissociate the components of the "cocktails." Refrigeration must not begin until a sufficient sleep and pharmacodynamic blocking have been obtained, else it might be inoperative and even aggressive: loss of the hypothermic advantage, increase in the oxygen consumption after it has been reduced by the action of the drugs. A well-started hibernation presents no further maintenance difficulties. The efficacious hibernation level varies from one patient to another. If simple pharmacodynamic hibernation is generally sufficient, there are cases in which deep hibernation proves absolutely necessary. Hypothermy below 34 C. (and as low as 30 C.) seems to be possessed of a lytic action of its own, which pharmacodynamic neurolysis cannot, of itself, procure. Georges and Cahn have defined "cortical temperature" as the temperature observed when extinction of pituitary reactivity has been obtained. When deep hypothermy has been obtained for twelve or twenty-four hours, its maintenance becomes easier and easier, with reduced amounts of drugs and refrigeration, and tends to become spontaneous. Suppression of the hypnogenics makes it possible to obtain wakeful hibernation; the patient, at 32 C. for instance, regains consciousness, swallows normally and does not complain of cold.

Some special cases must be noted. Resistance to hibernation is observed in neurosurgical patients as it is in other fields. Hypersensitivity to hibernation is a special characteristic of neurosurgical diseases. We have observed it in a case of exeresis of a myxedematous craniopharyngioma, after a clipping of the anterior cerebral for juxtaclinoidal aneurysms, and in several cases of cranial trauma followed by death (probably destructive diencephalic lesions). In all such cases, diencephalopituitary deficiency seemed to be the cause.

Indications for hibernation and hibernotherapy are exclusively limited to the acute neurovegetative syndrome. More and more frequently we observe a subacute or chronic vegetative syndrome whose evolution covers several weeks or several months, with characteristic increasing psychic indifference, anorexia of malnutrition, eschars, and finally cachexia with deep hydromineral disorders. Its frequency may be increased by hibernation in patients who would initially have succumbed and who nevertheless do not resist it. We wonder whether hibernation would not have fostered this subacute or chronic syndrome in cases in which destructive diencephalopituitary lesions are added to the initial irritative process. Any function-retarding therapy can then be aggravating. This syndrome should be the object of a stimulating therapy, perhaps of an endocrine nature.

CONCLUSIONS

Starting from sleep-producing formulas so inadequate that local anesthesia was long found to be at least preferable, neurosurgical narcosis had to be gradually adapted to the requirements set by the extreme sensitivity of a diseased and hypertensive brain. Hazardous in its early stages, narcosis has been freed of any dangerous consequences by a judicious selection of anesthetic and preanesthetic agents and by patient technical improvement in the methods as well as in the drugs used. Essential progress has been achieved since 1951, when vegetative prenarcosis and lysis of the vegetative nervous system (Laborit and Huguenot) and controlled hypotension (Guiot and Damoiseau) made possible a therapeutic approach that increased simultaneously the operability of the brain and its tolerance of the procedure. Cerebral surgery has

therefore been one of the principal beneficiaries of hibernotherapy according to the method described by Laborit, a therapy constituting a remarkable treatment of the acute central neurovegetative syndrome.

If the purely anesthetic problems have, as a whole, received satisfactory solutions, the problems of so-called reanimation have not yet reached quite the same stage. The operative limits have been broadened, and survival of the diseased or of the most severely traumatized patients now is almost always assured. But survivors with conditions that were formerly fatal have revealed pathologic conditions still uncleared, such as, in some cases, postoperative diencephalitis of long duration, finally ending in death. The secondary complications reveal new problems and suggest new research.

SCHLUSSFOLGERUNGEN

Seit den Tagen der Verwendung von Schlafmitteln, die so unzulänglich waren, dass die Lokalbetäubung bald den Vorzuggewann, musste sich die Narkose in der Chirurgie des Zentralnervensystems allmählich den besonderen Erfordernissen anpassen, die ein so empfindliches Organ wie ein erkranktes Gehirn zu stellen hat. Die Narkose, die anfänglich noch ihr Risiko hatte, ist jetzt durch eine urteilskräftige Auswahl der vor und zur Anästhesie angewandten Mittel und durch geduldige Verbesserung der Technik und der Mittel ihrer Gefahren beraubt worden. Wesentliche Fortschritte sind seit 1951 zu verzeichnen. Die vegetative Pränarkose und die Lysis des autonomen Nervensystems (Laborit und Huguenot) sowie die kontrollierte Hypertension (Guiot und Damoiseau) eröffneten einen Behandlungsweg, der gleichzeitig die Operabilität des Gehirns und die Verträglichkeit des Eingriffs verbesserte. Die Gehirnchirurgie gehört zu den Gebieten, die den grössten Nutzen aus der Hibernotherapie nach dem von Laborit beschriebenen Verfahren gezogen haben, einer Behandlung, die eine bemerkenswerte Massnahme bei akuten zentralen neurovegetativen Erscheinungen darstellt. Während die Probleme der reinen Anästhesie im ganzen zufriedenstellend gelöst worden sind, haben die Schwierigkeiten der sogenannten Reanimation noch nicht im selben Masse beseitigt werden können. Die operativen Möglichkeiten sind erweitert worden, und das Ueberleben der Erkrankten und selbst schwer verletzter Patienten ist heutzutage fast immer sichergestellt. Aber die Ueberlebenden aus der Gruppe, die in früheren Zeiten tödlich ausgegangen wären, entwickeln Krankheitserscheinungen, die bis heute ungeklärt sind, wie z.B. die postoperative Dienzephalitis, die lange anhält und schlieaslich tödlich endet. Die sekundären Komplikationen stellen neue Probleme dar und erfordern neue Forschungsarbeit.

RÉSUMÉ

Les méthodes d'anesthésie pour la neurochirurgie étaient si inefficaces que pendant longtemps on préféra recourir à l'anesthésie locale. La narcose en neurochirurgie a dû être adaptée graduellement aux exigences de l'extrême sensibilité d'un cerveau malade et hypertendu. La narcose —qui à ses débuts constituait un grand risque—est devenue sans danger par suite du choix judicieux des narcotiques, et d'un patient travail d'amélioration des techniques. C'est depuis 1951 que les progrès les plus grands ont été faits dans ce domaine, avec la prénarcose végétative et les médicaments à action lytique du système neuro-végétatif (Laborit et Huguenard). En contrôlant l'hypertension (Guiot et Damoiseau) on crée une technique augmentant à la fois l'operabilité du cerveau et sa tolérance. C'est pourquoi la chirurgie cérébrale a été une des principales bénéficiaires de l'hibernation suivant la méthode décrite par Laborit; cette thérapeutique constitue un traitement remarquable des syndromes aigus du système central neuro-végétatif.

Dans leur ensemble, les problèmes relevant purement de l'anesthésie, ont trouvé des solutions satisfaisantes, mais on ne peut en dire autant encore de la réanimation. Les limites de l'opérabilité ont été élargies, la survie des malades ou des grands traumatisés est maintenant presqe assurée. Mais les malades qui survivent dans ces cas présentent des symptômes encore inexpliqués, telle, quelquefois, la diencéphalite chronique dont l'issue est fatale. Les complications secondaires ouvrent la voie à de nouveax problèmes et à de nouvelles recherches.

CONCLUSIONES

A partir de fórmulas hipnóticas tan inadecuadas para anestesia local se encontró que al menos eran preferibles, la narcosis neuroquirúrgica ha tenido que ser adaptada gradualmente a los requerimientos establecidos por la extrema sensibilidad de un cerebro enfermo e hipertenso. Con riesgos en sus primeros estadíos, la narcosis ha sido liberada de cualquier consecuencia peligrosa por la selección juiciosa de los agentes anestésicos y preanestésicos y por el mejoramiento técnico en los métodos así como en las drogas. Se realizaron progresos esenciales desde 1951, cuando la prenarcosis vegetativa y lisis dl sistema nervioso vegetativo (Laborit y Huguenot) así como la hipertensión controlada (Guiot y Damoiseau), hicieron posible un abordaje terapéutico que aumentó simultáneamente la operabilidad del cerebro y su tolerancia al procedimiento. Por lo tanto la cirugía cerebral ha sido uno de los principales beneficiados por la hibernoterapia de acuerdo con el método descrito por Laborit, constituyendo un tratamiento notable del síndrome agudo neurovegetativo central.

Si los problemas anestésicos como un todo han recibido una solución satisfactoria, los problemas de la llamada reanimación no han sido solucionados en el mismo grado. Los límites operatorios se han ampliado y la supervivencia de los pacientes enfermos ó traumatizados gravemente es casi siempre segura. Pere los supervivientes en casos de naturaleza anteriormente fatal han revelado condiciones patológicas todavía no esclarecidas tales como diencefalitis postoperatoria de larga duración y término fatal. Las complicaciones secundarias revelan nuevos problemas y sugieren nuevas investigaciones.

CONCLUSIONI

Dal tempo in cui si cominciarono a usare farmaci ad azione ipnotica, cosí inadatti da essere di gran lunga inferiori all'anestesia locale, la narcosi si è venuta gradualmente adattando alla nuove necessitá delle neurochirurgia. Rischiosa all'inizio, la narcosi è stata gradualmente liberata da ogni dannosa conseguenza mediante un'opportuna scelta degli anestetici e dei preanestetici e per merito dei progressi tecnici.

I maggiori progressi sono stati fatti nel 1951, quando la prenarcosi vegetativa e il blocco del sistema nervoso vegetativo (Laborit e Huguenot) e l'ipotensione controllata (Guiot e Damoiseau) hanno aumentato le possibilità di intervento e le resistenze del cervello. La neurochirurgia è il campo principale dell'ibernazione, che è il metodo di cura delle sindromi acute centrali neurovegetative.

Se tuttavia i problemi puramente anestetici sono stati soddisfacentemente risolti, non altrettanto si può dire della cosidetta rianimazione. I limiti operatori sono stati allargati ed e possibile assicurare la sopravvivenza dei malati, ma coloro che sopravvivono ad affezioni un tempo fatali vanno incontro a quadri morbosi ancora oscuri, quali la diencefalite post-operatoria di lunga durata e di prognosi infausta. Queste complicazioni secondarie aprono nuovi problemi e impongono nuove ricerche.

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Hürthle Cell Tumors of the Thyroid Gland

JAMES A. DICKSON, M.D., M.S. (Surg.), F.A.C.S., F.I.C.S.,*
and WILLIAM E. B. HALL, M.D., F.C.A.P., F.A.C.P.**

CHAMBERSBURG, PENNSYLVANIA

IS it preferable to discontinue the use of the terms "Hürthle cells" and "Hürthle cell tumors of the thyroid gland"? There seems to be ample justification and popularity to justify continued use of these terms. The cells, as observed in Hürthle cell tumors and the Hürthle cell reaction, if we may so term it, present a definite and striking microscopic picture with varied cytologic manifestations. These cells may be present in many types of goiter; they play a significant or paramount role in many adenomas and, probably less commonly, in carcinomas of the thyroid gland. Our purpose is to review the entire problem of Hürthle cells as observed in the thyroid, which have been a "barbedwire obstacle" in the literature on the thyroid gland.

Historical Review.—Hürthle,[1] a German physiologist, was one of the first to describe the striking, large acidophilic cells of the thyroid gland in 1894. He postulated that these large acidophilic cells had their origin from a special interfollicular (parafollicular) type of thyroid cell. The existence of such a special type of thyroid cell has been doubted by more recent investigators.[2] Baber[3] had reported previously on a similar type of cell in man as early as 1876 and 1881.

Askanazy,[4] in 1898, described these large, acidophilic cells as occurring in the thyroids of patients with thyrotoxicosis. Since then, many have called attention to similar observations in thyroids removed from patients with this disease.[5]

Langhans,[6] in 1907, referred to the distinctive cytologic pattern and characteristics of these tumors by stating that "one glance through the microscope suffices to establish the diagnosis." He described what he thought to be a specific type of thyroid tumor in which the component cells were large, oxyphilic and arranged in alveoli or trabeculae.

Getzowa[7] termed these tumors "struma postbranchialis" and maintained that these types of neoplasm had their origin from the ultimobranchial bodies. It may, in our opinion, be fairly stated that this view as to their origin is no longer tenable.

Broders,[5b] in 1929, published a paper entitled "Regenerative Hyperplasia in Exophthalmic Goiter: A Condition Simulating Carcinoma." The microscopic or cytologic characteristics of the cells described in this paper seem quite similar to those associated with the conditions here to be described. Clute and Warren[8] also noted the similarity between these oxyphilic tumor cells and the involutionary changes associated with thyroid hyperplasia.

Wegelin[2d] and others[9] have expressed the opinion that the large oxyphilic cells in tumors of this type do not represent a separate anatomic type of cellular entity but rather a functional unit or change. Wilensky and Kauffman[5m] seem to share this opinion with regard to the significance of this type of cell.

A powerful stimulus discussion of Hürthle cell tumors in the literature on thyroid disease, at least in America, was supplied

From the Chambersburg Hospital.
*Member of Surgical Staff, Chambersburg Hospital and Surgical Consultant to Mont Alto State Sanatorium, South Mountain, Pennsylvania.
**Pathologist at the Chambersburg Hospital and Waynesboro Hospital and Consultant Pathologist at Mont Alto State Sanatorium, South Mountain, Pennsylvania.
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by Ewing.[10] He offered an excellent description of the structure of these Hürthle cell tumors, and on page 524 of his text one finds the Hürthle cell tumor depicted in an illustration.

The term "onkocyte" was introduced by Hamperl.[11] Apparently these cells may be easily demonstrated by means of special inclusion stains.[12] This type of cell is supposed to represent a degenerative transformation of parenchymal cells of the thyroid, but it may also exist in the parathyroid, adrenal, salivary and pituitary glands. Hamperl[11] has mentioned two other cell types observed in the thyroid, i.e., the colloid cells of Langendorff and the interfollicular (parafollicular) cells of Hürthle. This communication has thus caused no small degree of confusion. What Willis[9b] has said about the interfollicular cell may also be said about the "onkocyte." Eisenberg and Wallerstein[5e] reported that the probable source of the Hürthle cell tumor is parathyroid tissue. They maintained that the Hürthle cell is similar to the pale, oxyphilic parathyroid cell of Welsh. Similar confusion has been introduced by identification of these cells with similar ones. Regardless of the source of origin,[13] these large, acidophilic cells, as they occur in various types of goiters, present a striking microscopic appearance, and in our opinion, for want of a better designation they should continue to be called Hürthle cells.

Willis[9b] stated that the term "Hürthle cell tumor" as currently used is "trebly unfortunate (1) because there is no real evidence that the tumors are related to the cells described by Hürthle, (2) because the very existence of special interfollicular cells in the thyroid is doubtful, and (3) because even if special cells of this kind exist and the tumors arise from them, the eponymic name is inappropriate, since Baber[3] described the same cells seventeen years before Hürthle." Willis[9b] suggested the term "eosinophilic large-celled tumor of the thyroid." Regardless of the origin of these cells, which probably represent a structural variant of ordinary thyroid epithelium, we concur with Chesky, Dresse and Hellwig[5c] that the name Hürthle cell tumor is too well established for its use to be discontinued.

Wegelin's viewpoint[2c] and that of Wilensky and Kauffman,[2d] that the Hürthle cell is a physiopathologic rather than an anatomic variant of thyroid cells, has been given additional impetus by Friedman.[14] Friedman has pointed out that the development of Hürthle cells takes place not only in cases of thyroid hyperplasia, Hashimoto's disease or exhaustion atrophy but as a consequence of irradiation, the administration of thiouracil and partial or subtotal thyroidectomy. Certain epithelial alterations, the most prominent of which is the formation of Hürthle cells, he referred to under the designation "cellular involution."

The confusion in the literature on the pathologic character of thyroid tumor, so far as Hürthle cell tumors[15] are concerned, seems to us unwarranted. Nearly all of the aforementioned communications seem to be describing a similar type of cell and tumors with an identical or very similar cytologic picture.

Definition of Hürthle Cell Tumor and the Hürthle Cell Reaction.—This is a striking, specific and very definite type of cellular reaction or change occurring in the thyroid gland, with many variable microscopic features. The cells are of the large acidophilic type (or oxyphilic, as they have also been called). They are often large, sometimes of giant size; finely granular, eosinophilic, opaque and sometimes clear. These cells may be cuboidal, cylindric or irregularly polyhedral. Pleomorphism is often present and may be present to an extreme degree. The nuclei may be small or large, they are vesicular, often with

visible and prominent nucleoli and often markedly hyperchromatic.

Microscopically, the cells may be arranged in almost any type of grouping—trabecular, alveolar, follicular or papillary.[16] For this reason, it is difficult to consider them a subfollicular group or to assign them to any other single similar subgrouping or classification as regards arrangement.

There seems little reason for the pronounced confusion in the literature concerning such a characteristic, striking microscopic appearance as is characteristic of this type of tumor. Certainly the proper names of Getzowa, Askanazy, Langhans, Langendorff, Baber, etc., need not add to the confusion. We refer simply to the Hürthle cell as the large type of acidophilic cell with multiple types of grouping or microscopic arrangements or even without any specific grouping, as observed in many types of goiter. The same cells may occur in adenoma or, more rarely, in carcinoma of the thyroid, as a small or insignificant part, but these cells may also be the major or predominant type of cell found in such cases.[17]

When Hürthle cells exist to an insignificant extent in nontumorous thyroids or glands with thyrotoxicosis, etc., we suggest the term "Hürthle cell reaction." This cytologic picture may, of course, be but one of the manifold cellular variations observed in adenomas or carcinomas of the thyroid gland.[9a] The Hürthle type of cell may comprise the predominant or larger portion of a particular tumor or mass in the thyroid, or it may be only a very small part of the total picture. If this type of cell predominates or represents the major portion of a tumor, we are of the opinion that the growth should be termed Hürthle cell tumor, i.e., benign or malignant Hürthle cell tumor.

In more recent years, some have urged that the malignant nature of these tumors be emphasized. Indeed, the tumor is now considered malignant by those who would subscribe to the most recent edition of the "Manual of Tumor Nomenclature" prepared by the American Cancer Society in 1951.[18] In the latter, the designations "Hürthle cell adenoma" and "Hürthle cell tumor" have been abandoned, but the designations "Hürthle cell adenocarcinoma" and "Hürthle cell carcinoma" are recommended. One cannot deny that these large, eosinophilic cells (Hürthle cells) do occur in many types of goiter and that these same cells may predominate in certain adenomas of the thyroid. Categorical designation of all Hürthle cell adenomas as malignant seems reprehensible, in spite of the fact that the true carcinomas or Hürthle cell adenocarcinomas may behave clinically as if they were benign. These cells, microscopically, may often simulate malignant features. However, there does seem to be a justifiable place and reason for the continued use of "Hürthle cell adenoma" and, if you will, the "Hürthle cell reaction," as well as the true Hürthle cell carcinoma or the Hürthle cell adenocarcinoma of the thyroid. A place for the benign form of the Hürthle cell in tumors of the thyroid is amply recognized by the authoritative publications of Warren and Meissner in "Tumors of the Thyroid Gland," published by the Armed Forces Institute of Pathology,[17b] and the "Standard Nomenclature of Diseases and Operations."[19]

REPORT OF ILLUSTRATIVE CASES

CASE 1.—The patient, P. S., lost 20 pounds (9.1 Kg.) in weight within three months, associated with palpitation, nervousness, excessive fatigue, excessive appetite and intolerance to heat; perspired freely, and complained of weakness in the quadraceps muscles. Three preoperative basal metabolism tests were done; the results were plus 55, plus 57 and plus 71. Examination disclosed the thyroid to be firm and the right lobe enlarged. The

diagnosis was toxic nodular goiter. Preoperatively the patient was given propylthiouracil, followed by Lugol's solution. Subtotal thyroidectomy was performed on March 5, 1948, after which irradiation was administered over the thyroid isthmus.

The original pathologic report was made elsewhere, and the pathologist's diagnosis was Hürthle cell adenocarcinoma of the thyroid gland. The following pathologic report was made on March 5 from a study of only the adenomatous portion of the excised tissue:

"The microsections show an encapsulated thyroid adenoma of a mixed, predominantly microfollicular type, void of hyperthyroid reaction and surrounded by a thick, compact fibrous capsule. The acinar of type cell is cuboidal, with pale, granular, almost hydropic pink-grey cytoplasm. Scattered irregularly throughout the adenoma are acini and clumps of cells composed of characteristic large, pink-staining cells of the Hürthle type. These cells show moderate pleomorphism, definite nuclear hyperchromia and pyknosis but no mitotic figures. There were six noteworthy features: 1. A number of acini were lined *only in part* with Hürthle-type cells, the other cells conforming in size, staining, form and arrangement with the usual thyroid acinar epithelium (this would suggest a single identical cell origin of the two types of cells). 2. In involved acini containing Hürthle cells, the latter occasionally showed hyperplastic, multilayered cell clumps. 3. Where identifiable, Hürthle cell acini always contained colloid. 4. No mitotic figures were observed, regardless of the degree of pleomorphism, nuclear daub, giant forms and cell disorganization. 5. Disorganized clumps of Hürthle cells could be seen, void of acinar arrangement and usually intermixed with simple follicular and "Hürthle acinar forms; this was not accompanied by any stromal fibrous tissue proliferation. 6. There was consistent confinement of the Hürthle cells, with refusal to bridge, invade or cross the fibrous capsule. The presence of Hürthle cells outside the capsule would have been an influencing factor in interpretation of the neoplasia but would not have been accepted as a positive index of malignancy. The tumor was originally diagnosed as a Hürthle cell carcinoma. In the light of considerable experience with this type of tumor and the subsequent postoperative interval of excellent health (six years), this tumor is now considered a Hürthle cell formation in a simple follicular thyroid adenoma unrelated to the surrounding hyperplastic thyroid tissue.

Follow-up examinations in May 1948, June 1949, June 1950, July 1951 and September 1953 showed no evidence of recurrent or cervical adenopathic change.

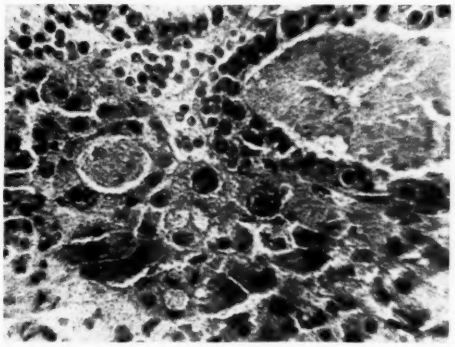

Fig. 2. (P. S., Case 1).—Hürthle cell reaction in simple follicular thyroid adenoma. Two follicles in upper right border, with acinus on right border showing typical simple small cuboidal epithelium on the left side, assuming eosinophilia and enlargement to Hürthle form on the upper and lower borders of the acinus identical with lower central disorganized clump of Hürthle cells in the general field. In center, note small Hürthle acinus and two large, vesicular nuclei in Hürthle cells. Remainder of nuclei tend to be pyknotic, a characteristic of degeneration and involution. × 440.

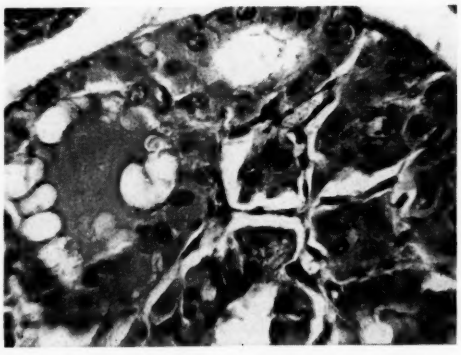

Fig. 1. (E. K., Case 2).—Hürthle cell reaction in diffuse toxic goiter. Note well-defined acini and nonacinar clumps of Hürthle cell epithelium, with clearly defined fibrous tissue septums supporting individual acini and clumps. There is slight nuclear pleomorphism with occasional pyknosis. The lobule periphery is sharply defined, without bridging. Note the multilayering in the lower central acinus; colloid in acinus.* × 440.

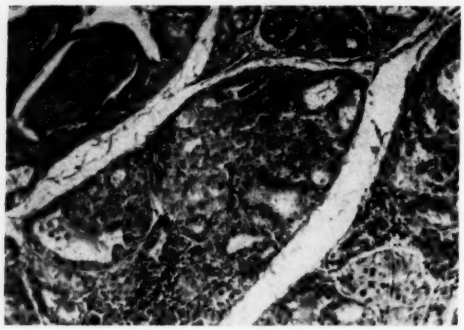

Fig. 3. (E. K., Case 2).—Hürthle cell reaction in toxic diffuse goiter. Note major lobules of acini and clumps of Hürthle cell epithelium with fields of lymphocytes. There are large, non-Hürthle cell acini filled with deep-staining colloid at upper left. Note consistent confinement of Hürthle cells and acini, with refusal to bridge, invade or cross interlobular space; also absence of fibrous tissue proliferation. × 100.

CASE 2.—The original complaints of E. K. were of a loss of 23 pounds (10.4 Kg.) in six months, palpitation, nervousness, tremor and excessive fatigue. The result of the first test of basal metabolism was plus 28; that of the one just prior to operation was plus 10. On examination the patient had a diffuse, firm thyroid, slightly enlarged. In preparation for surgical treatment, 1-methyl-2-mercaptiomidazole (Tapazole®) was given, followed by Lugol's solution for two weeks. The diagnosis of toxic diffuse goiter was made, and a subtotal thyroidectomy was performed on Aug. 11, 1952.

The pathologic report on the same day was as follows: "The microsections are of thyroid made up of lobules containing acini varying considerably in size and form, sometimes with variable epithelial hyperplasia and papillosis indicating the hyperthyroid state. Many acini are lined with unusually large pink-staining cells, interpretable as Hürthle cells. These cells show moderate cellular pleomorphism and definite nuclear hyperchromia and pyknosis, but no mitotic figures, and do not share in the severe hyperplasia and feathering of the general toxic picture. Noteworthy were six features. 1. At least one acinus was lined *only in part* with Hürthle cells, the other cells conforming in size, staining, form and arrangement with the usual thyroid acinar epithelium (this would suggest a single identical cytologic origin of the types of cells). 2. In involved acini containing Hürthle cells, the latter often showed multilayered hyperplastic cell clumps within the acinar cavity. 3. Where identifiable, Hürthle cell acini always contained colloid. 4. No mitotic figures were observed, regardless of the degree of pleomorphism and cell disorganization (their occasional presence, however, should not be taken as a positive index of neoplasia). 5. Clumps of Hürthle cells could be seen, void of acinar arrangements or encapsulation, particularly within one major field of lymphocytes. 6. There was consistent confinement of the Hürthle cells, with refusal to bridge, invade or cross interlobular spaces, fibrous septums or capsules or to penetrate vessels. The Hürthle cells were considered nonmalignant cells in a diffuse toxic goiter.

In October 1952 and October 1953, check-up examinations disclosed no evidence of recurrence, and the scar was well healed.

Thyroids with Hürthle Cell Tumors and Hürthle Cell Reaction.—The Hürthle cell tumor and the Hürthle cell reaction may be associated with almost any type of goiter and in many thyroids with other pathologic conditions.

Hürthle cells may be observed incidentally in any type of goiter, particularly in the gland of thyrotoxicosis and those previously mentioned by Friedman.[20] Broders[5b] termed it "regenerative hyperplasia" and pointed out for the first time, so far

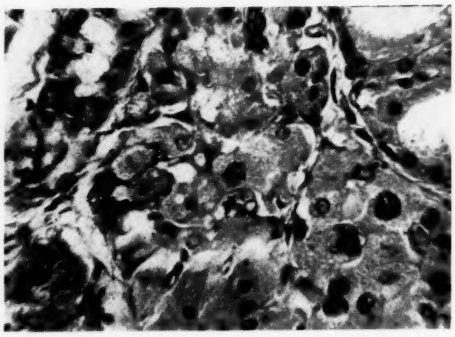

Fig. 4. (E. K., Case 2).—Hürthle cell reaction in toxic diffuse goiter. Hürthle cells are in acinar formation and disorganized clumps. Note delicate fibrous tissue septums, and definite cell groups in these clumps. Moderate nuclear pyknosis, pleomorphism and vesicular change were observed, but there were no mitotic figures. × 440.

as we know the importance of not interpreting the presence of cells of this type in the thyroid as synonymous with thyroid cancer. We wish to emphasize this point strongly.

Friedman[20] interpreted this cellular reaction as a type of cellular involution. He observed it in goiters associated with myxedema or thyrotoxicosis; glands previously treated with antithyroid drugs, (thiouracil, etc.); glands previously treated by irradiation, residual thyroid glandular tissue after subtotal removal of the thyroid gland. All of this seems to lend support to the theory of some type of functional change in the thyroid cells rather than to the occurrence of a certain anatomic cell in the thyroid (Wilensky and Kauffman.)[2d] We concur in this opinion.

There seems little doubt, however, that Hürthle cells have a definite neoplastic counterpart in no small number of goiters. They may make up the whole, or only part, of the microscopic and gross pathologic picture in cases of thyroid adenoma, whether benign or malignant. Less commonly they form a part of, or are predominantly or solely, the type of cell seen in some thyroid carcinomas.

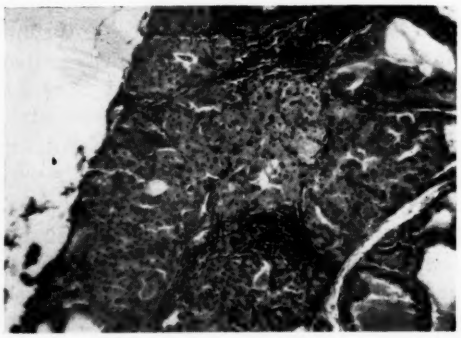

Fig. 5. (C. K., Case 2).—Hürthle cell reaction in toxic diffuse goiter. Note Hürthle cells, usually in clumps without acinar formation, developing in background of lymphocytes, without circumscribing fibrosis; no fibrosis bridging, no Hürthle cell bridging, invasion or crossing of inter-lobular space, no extension beyond orderly border of lobule. Non-Hürthle acini along right border. × 100.

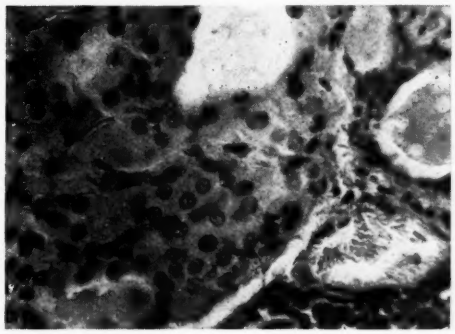

Fig. 6. (E. K., Case 2).—Hürthle cell reaction in toxic diffuse goiter. Note Hürthle cells in acini and in nonacinar clumps, adjacent to large capillary sinus and field of lymphocytes. Note uniformity of nuclei, colloid in acini, and delicate fibrous septums between smaller cell clump units. × 440.

Benign vs. Malignant Hürthle Cell Tumors.—All surgeons know the fallacy of relying entirely on microscopic criteria for distinguishing benign from malignant tumors in the thyroid gland. Hürthle cell tumors are no exception to this rule and are another element in a continually perplexing problem. It is with those tumors which often have extreme cellular pleomorphism that one needs to bring into play all the criteria of malignancy on microscopic examination, i.e., capsular invasion, vessel invasion, lymphatic invasion or gross or microscopic nodal metastasis. Elastic tissue stains such as those of Verhoeff or Weigert may help to identify blood vessel walls when there is vascular invasion as described by Warren and Meissner.[17b] Conceivably, there may be metastasis from carcinoma of the thyroid without either capsular invasion or vessel invasion but such cases must be uncommon. The term "benign metastasizing goiter" has caused considerable confusion; it should be discarded. It may be that only after years of careful follow-up can the diagnosis of some of these tumors be made accurately

as concerns their malignancy or benignancy; this was emphasized by Ward.[21] In other words, it may not, at the moment, be possible to diagnose these carcinomas microscopically in some few cases.

Management of Malignant Hürthle Cell Tumors.—No suspect nodule or mass in the thyroid gland should simply be enucleated. All should be excised with sufficient surrounding tissue to avoid implantation or dissemination of the tumor process and to obtain an adequate specimen for study with regard to capsular and vessel invasion.

If the tumor is diagnosed as a malignant Hürthle cell tumor after careful study, either by gross or microscopic criteria for malignancy, then a more radical operation is indicated than has previously been contemplated. Total removal of the involved lobes and the isthmus, with excision of the regional bilateral lymph nodes, would seem preferable. In removal of lymph nodes on one or both sides, just as in cases of papillary carcinoma of the thyroid, consideration should be given to the nodes involved in spread from thyroid cancer as recently mentioned by Crile,[22] i.e., nodes of the jugular and carotid chains and the retrothyroid and delphian lymph nodes.

It is certainly not possible in this presentation to discuss at length all of the technical procedures to be followed even with this one type of thyroid malignant disease, whether primary or secondary. With the Hürthle cell carcinoma, as with some other types of thyroid cancer, a more rational and, at times, less mutilating type of radical operation is indicated. The nodes excised should be those involved in the spread from cancer of the thyroid. The standard or conventional type of radical neck dissection will probably not suffice for this type of carcinoma, just as it has not for many other cancers of the thyroid.

An ample number of incompletely removed primary carcinomas has been reported to emphasize the importance of complete removal of all the involved thyroid lobes and the isthmus at the primary procedure.[23] This procedure should be followed by removal of the lymph concerned in the metastasis of the thyroid cancer.[22] The nodes should be removed in continuity or in groups in their surrounding fat, not excised individually. If there has been microscopic evidence of vessel invasion, certainly the internal jugular vein on the involved side should be sacrificed, as is done in the conventional neck dissection. Little seems to have been gained by postoperative irradiation therapy. Most palliation from postoperative irradiation seems to be derived from the effect on metastatic deposits of the Hürthle cell carcinomas rather than the thyroid and cervical regions.

COMMENT

The diagnosis of Hürthle cell malignant adenoma or Hürthle cell carcinoma may be difficult, as with some other types of thyroid cancer. Such true cases, it seems, used to be actually rare, although some surgeons have collected rather large groups of malignant Hürthle cell tumors.[24]

On the basis of the extreme pleomorphism and variability of the cells in some of these tumors, one wonders whether some of those labeled malignant were not actually benign—especially when, after a number of years, there is no follow-up evidence of a malignant process or a recurrence.

Unfortunately, Hürthle cell carcinoma often resembles a benign adenoma clinically and may metastasize. This, however, is not yet sufficient justification, in our opinion, for categorically classifying all such tumors as actually malignant. This opinion is shared by Chesky, Dreese and Hellwig[5e] and others.[26] As in the cases here reported, many goiters exhibit these cells in significant or predominating num-

bers. In such cases the condition may be actually a simple Hürthle cell reaction or a Hürthle cell adenoma. The tumor may not be malignant and should not be considered malignant without histologic or clinical justification. Broders[5b] emphasized this point adequately many years ago.

It would seem difficult to classify these tumors as purely follicular, trabecular, papillary or alveolar, as suggested by Chesky, Dreese and Hellwig[5c] and Goldenberg[12] because admixtures of all these types occur rather frequently. The cellular pattern varies considerably at times, even in the same goiter.

We suggest that the terms "onkocyte" of Hamperl,[26] metastasizing goiter,[27] colloid cells of Langendorff[26] and parafollicular or interfollicular[28] designations be discontinued. Continued association of additional proper names, such as Getzowa,[7] Langhans,[6] Askanazy,[4] and Baber[3] with tumors of the type here described, serve only to confuse.[15a] As has been suggested, the large, eosinophilic cells occurring in various types of goiter, regardless of their origin, should be designated by the terms Hürthle cells, Hürthle cell reaction, Hürthle cell adenoma or Hürthle cell carcinoma or adenocarinoma, according to the situation or given condition in the thyroid.

Why is the survival rate so high in some of the reported series of Hürthle cell carcinomas? Does this type of carcinoma offer a much better prognosis than other types of carcinoma of the thyroid, even the papillary type? The five-year survival rates for all types of thyroid carcinoma, as reported by numerous observers in the medical literature,[28] has ranged from 7.8 per cent to as high as 61 per cent (Pemberton).[30] The clinical course of many Hürthle cell cancers has been prolonged, the disease remaining localized in the neck for many years in some cases.[23a] Chesky and his associates[2c] stated that 88 per cent of their patients were alive one and one-half to nine years after surgical intervention and that 80 per cent of the total number were free of disease after local surgical treatment in 96 per cent of the group. Goldenberg,[12] reporting 22 cases of Hürthle cell carcinoma, noted a very high rate of survival, at least 68 per cent, after less radical operations in most of the cases.

In our opinion this unusually high survival rate for Hürthle cell neoplasms designated as malignant is due not to a low grade of malignancy but to the pathologist's improper designation of some of these tumors as malignant. This would appear to be confirmed by the figures of Frazell and Foote,[31] whose end results with Hürthle cell cancers were not nearly so favorable with only one-third of the patients falling into the five-year follow-up series and being alive and free of disease during this period. These authors[31] concluded that a more radical approach to the treatment of these carcinomas of the thyroid is indicated.

Careful study of these tumors for evidence of malignancy seems indicated, particularly because of their microscopic characteristics. In the absence of vessel or capsular invasion the diagnosis of Hürthle cell carcinoma is indeed difficult, and it is rendered more so by the frequently extreme pleomorphism of the cells.

SUMMARY

The terms "Hürthle cell reaction" and "benign and malignant Hürthle cell tumors" should be continued as a distinct and separate entity in the pathologic field with regard to thyroid tumor. The large eosinophilic Hürthle cells present a distinct, striking and characteristic appearance in the thyroid gland. It seems difficult to classify or subgroup tumors made up of these cells because of the variability of the cellular arrangement or grouping, which may be of almost any type.

The term "Hürthle cell reaction" has been used herein to describe the presence of these cells in various types of goiter, e.g., thyrotoxicosis or Hashimoto's disease, after irradiation of the thyroid and in the tissue remaining after subtotal thyroidectomy. When these cells are observed significantly in the thyroid, not as part of an adenoma or a carcinoma the authors have used the term "Hürthle cell reaction." The Hürthle cell reaction is to be distinguished from Hürthle cell adenoma and Hürthle cell carcinoma or adenocarcinoma. When these cells predominate in the tumor, they suggest the continued use of the terms Hürthle cell adenoma and Hürthle cell carcinoma.

These large eosinophilic cells (Hürthle cells) occurring in various types of goiters and adenomas cannot all be categorically designated as malignant. Certainly, the designation of all Hürthle cell adenomas as malignant seems reprehensible.

Illustrative cases of Hürthle cell tumors are reported to exemplify the practical problems involved and to illustrate the characteristics of this type of tumor.

The difficulties encountered in establishing the diagnosis of true Hürthle cell carcinoma or Hürthle cell adenocarcinoma are mentioned, as is their more radical, yet rational, surgical management.

RÉSUMÉ

Pour les tumeurs de la glande thyroïde, les termes "réaction de la cellule de Hurthle" et "tumeurs bénignes et malignes de la cellule de Hurthle" devraient rester une entité pathologique distincte. La grande cellule éosinophile de Hurthle dans la glande thyroïde présente des caractéristiques frappantes. Il paraît difficile de classer ou de grouper lestumeurs de ces cellules, en raison de la variabilité de leur disposition qui s'apparente à presque n'importe quel autre type de cellules.

Les auteurs ont ici utilisé le terme de "réaction de la cel lule de Hurthle" pour décrire la présence de ces cellules dans de nombreux types de goîtres, tels la thyréotoxicose, la maladie de Hashimoto, ou après l'irradiation de la thyroïde, ou dans les vestiges tissulaires après thyroïdectomie subtotale. On parle de "réaction de la cellule de Hurthle" lorsque ces cellules sont observées dans la thyroïde, sans qu'elles fassent partie d'un adénome ou d'un carcinome. La "réaction de la cellule de Hurthle" est à distinguer de celle de l'adénome, du carcinome et de l'adénocarcinome. Lorsque ces cellules prédominent dans la tumeur, il faut utiliser les termes "d'adénome de Hurthle," ou "carcinome de Hurthle".

Ces grandes cellules éosinophiles (cellules de Hurthle) que l'on rencontre dans de nombreux types de goîtres et d'adénomes, ne peuvent être catégoriquement définies comme étant malignes. Il est certainement erroné de désigner comme malins tous les adénomes de la cellule de Hurthle.

L'auteur illustre par des cas les caractéristiques de ce type de tumeur, afin de simplifier les problèmes pratiques qui en résultent.

Il énumère les difficultés rencontrées dans l'établissement du diagnostic du vrai carcinome ou de l'adénocarcinome de la cellule de Hurthle, et insiste sur leur traitement chirurgical plus radical.

ZUSAMMENFASSUNG

Die Benennungen "Hürthle-Zellen-Reaktion" und "gutartige und bösartige Hürthle-Zellen-Geschwülste" sollten zur Kennzeichnung einer umschriebenen und eigenartigen pathologischen Einheit auf dem Gebiete der Schilddrüsengeschwülste beibehalten werden. Die grossen eosinophilen Hürthle-Zellen haben ein eigenartiges und charakteristisches Aussehen in

der Schilddrüse. Aus diesen Zellen bestehende Geschwülste lassen sich wegen der Verschiedenartigkeit des Aufbaus und der Gruppierung der Zellen offenbar schwer in Klassen und Unterabteilungen einordnen.

In der vorliegenden Arbeit wird die Bezeichnung "Hürthle-Zellen-Reaktion" benutzt, um die Anwesenheit dieser Zellen in verschiedenen Formen des Kropfes, z.B. Basedowscher oder Hashimotoscher Krankheit, nach Schilddrüsenbestrahlung und in dem nach subtotaler Schilddrüsenresektion zurückbleibenden Gewebe zu beschrieben. Die Bezeichnung "Hürthle-Zellen-Reaktion" kommt nur dann zur Anwendung, wenn diese Zellen ausdrücklich im Schilddrüsengewebe selbst und nicht in einem Adenom oder Karzinom zur Beobachtung kommen. Die "Hürthle-Zellen-Reaktion" muss also vom Hürthle-Zellen-Adenom und vom Hürthle-Zellen-Karzinom oder-Adenokarzinom unterschieden werden. Wenn diese Zellen eine hervorragende Rolle innerhalb der Geschwulst spielen, sollte man sich entschliessen, die Bezeichnungen Hürthle - Zellen - Adenom und Hürthle-Zellen-Karzinom beizubehalten.

Nicht alle diese grossen eosinophilen Zellen (Hürthle-Zellen), die in verschiedenen Formen von Kröpfen und Adenomen vorkommen, können mit Bestimmtheit als bösartig bezeichnet werden, und sicherlich ist es anfechtbar, alle Hürthle-Zellen-Adenome als bösartig anzusehen.

Zur Illustrierung der praktischen Probleme und der Eigenarten dieser Geschwulstform werden erläuternde Fälle von Hürthle-Zellen-Geschwülsten angeführt.

Ferner wird auf die Schwierigkeiten der Diagnose echter Hürthle-Zellen-Karzinome und Hürthle-Zellen-Adenokarzinome eingegangen sowie auf ihre chirurgische Behandlung, die einen zwar radikalen aber den einzigen vernünftigen Ausweg bildet.

RESUMEN

El término "reacción celular de Hurthle" y "tumor benigno de células de Hurthle," debe ser continuado como una entidad diferente en el campo patológico de los tumores tiroideos. Las grandes células eosinófilas de Hurthle presentan una característica distinta y notable en la glándula tiroides. Parece difícil clasificar los tumores constituídos por éstas células a causa de la gran variación de su disposición celular, que puede ser casi de cualquier tipo.

El térmico "reacción celular de Hurthle" se ha usado para describir la presencia de estas células en varios tipos de bocios, tales como los de la tirotoxicosis ó enfermedad de Hashimoto, después de la irradiación del tiroides y en el remanente tisular de la tiroidectomía subtotal. Cuando estas células se observan significativamente en el tiroides, no como una parte de adenoma ó carcinoma, se usa el término "reacción celular de Hurthle." Esta reacción debe distinguirse del adenoma celular de Hurthle y del carcinoma ó adenocarcinoma celular de Hurthle. Cuando estas células predominan en el tumor se sugiere el uso del término adenoma celular de Hurthle y carcinoma celular de Hurthle.

Estas grandes células eosinófilas presentes en varios tipos de bocios y adenomas no pueden señalarse categóricamente como malignas, de hecho es censurable la designación de todos los adenomas celulares de Hurthle como adenomas malignos.

Se comunican casos ilustrativos de tumores celulares de Hurthle para ejemplificar los problemas prácticos y para ilustrar las características de este tipo de tumor.

Se mencionan las dificultades encontradas en el establecimiento del diagnóstico del verdadero carcinoma celular de Hurthle ó adenocarcinoma celular de Hurthle, así como su tratamiento más radical y racional.

RIASSUNTO

I termini "reazione a cellule di Hurtle" e "tumori benigni e maligni a cellule di Hurtle" devono essere mantenuti per significare due aspetti ben distinti della patologia della tiroide.

Le cellule di Hurtle si presentano nella tiroide in maniera evidente e caratteristica. Non è facile classificare i tumori che ne sono provvisti, a causa della grande variabilità nell'aspetto e nella disposizione di esse.

Per "reazione a cellule di Hurtle" si intende la presenza di queste cellule in vari tipi di gozzo, nella tireotossicosi e nella malattia di Hashimoto, o nella tiroide residua dopo resezione e roentgenterapia, ma in seno al tessuto tiroideo e non nel contesto di adenomi o cancri.

Quando invece le cellule si trovano nel tumore, allora si deve parlare di adenoma o carcinoma a cellule di Hurtle.

Sono grandi cellule eosinofile che non devono, quindi, essere sempre considerate segno di malignità.

Vengono presentati alcuni casi dimostrativi di tumori a cellule di Hurtle; viene messa in luce la difficoltà della diagnosi e la necessità dell'intervento radicale nelle forme maligne.

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No picture of life today is even worth a glance that does not show the bacteria as the foundation of life itself, the broad base of the pyramid on which all the rest is erected. We know them well enough as our most terrible enemies. But man's power over the pathogenic forms advances with a certainty of purpose, a display of courage and intelligence that heartens us back to a belief in ourselves. And in truth the deathly seeds that slay us still are the least significant of the whole lot; they are expensive hothouse parasites, so finicking in their requirements, so overspecialized in their adaptations, that they have written their own doom in time.

The bacteria which fire my imagination are those that I smell as I walk these days through the dripping woods, where the sodden leaves no longer rustle. I call it the smell of loam, but of a truth loam is no more than ordinary earth rich in soil bacteria. It is their gases which I scent, as it is the emanations from other sorts that generate the fetid odor of a bog, the stench of a carcass in the woods, the delectable reek of ferment in the hay-crammed barn.

It is among these harmless sorts that there flourish species which assist to break down the naked rock that once was the five continents thrust out of the seven seas; they have made them habitable for the rest of life. Green plants—the source directly or indirectly of all the food, fuel and apparel that we use,—would find life unendurable but for the bacteria. And but for the kinds that inhabit symbiotically the digestive tracts of animals, the tough cellulose of plant food could never be dissolved and assimilated. Men, as well as insects and legumes, live out their days in an unconscious dependence upon organisms so minute that, like the angels of metaphysical monks, ten thousand may, (and frequently do) stand on the point of a needle, and so numerous that they surpass all the stars in heaven.

—*Peattie*

Evaluation of Urologic Problems from the Medicolegal Point of View

LEONARD PAUL WERSHUB, M.D., F.A.C.S., F.I.C.S., D.U.

NEW YORK CITY, NEW YORK

IN private practice, the urologist is not primarily concerned with the exciting cause of a urologic lesion. If he can make an accurate diagnosis, understand the etiologic factors and provide the treatment the pathologic process requires, the basic cause is a secondary matter. In industry, the urologist finds himself in a somewhat altered position. He has added responsibilities in his role as an industrial specialist. He must be cognizant of the fact that merely because the industrial worker is referred for a urologic opinion, it does not necessarily follow that the underlying pathologic process is confined to the genitourinary tract. He must not assume (neither must he overlook the possibility) that if a urologic lesion is present it may be the direct result of the occupational environment. An employee stricken at work is entitled to compensation and medical benefits for any condition caused by accidental injury or by an occupational disease arising out of and in the course of his employment. Therefore, the exciting cause or contributory factor of the underlying urologic lesion becomes a matter of immediate concern.

The doctor must determine whether the alleged trauma produced the present complaint of the patient or was a pre-existing condition aggravated to the point at which operation or other treatment becomes imperative. He must know whether there has been any history of a fall, blow, contusion or indirect trauma, and whether the occupational environment is in any way related to the urologic lesion. These are important questions confronting the physician who is also aware that acute symptoms in persons affected by chronic urologic disorders frequently develop after an accident occurs. All physicians are aware that the average person is prone to blame his present affliction upon a previous accident. No matter how intelligently one may approach the problem, there is often great difficulty in determining just what is to be regarded as cause and what may be attributed to mere coincidence. The differentiation becomes even more difficult because of the fact that deeply embedded in human thinking is the habit of drawing false conclusions, a habit well described by the Latin phrase, *post hoc; ergo propter hoc* (after it; therefore because of it).

Injuries and diseases of the genitourinary system and their evaluation from an industrial angle have always been moot subjects, and the cases which ultimately appear before the industrial commission are likely to be controversial; if they were not, they would never have appeared for a hearing. In the handling of these cases one must ever be aware of one's responsibility to the patient, to the employer, and to the industrial commission as well.

Renal Calculus.—Urolithiasis poses one of the most important problems in industrial medicine by virtue of its comparatively high incidence and the difficulty of establishing its cause and the relation thereof to industry. Though many plausible theories have been advanced and ac-

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cepted with regard to etiologic factors in stone formation, the exact cause is still unknown. All agree that no single causal factor is responsible. I have appeared in court on many occasions and witnessed efforts made by a zealous lawyer to show how trauma can produce a kidney stone. Where the injury is of such magnitude (multiple fractures) as to immobilize the patient for a prolonged period, the possibility of stone formation is never denied; but when no severe trauma has been sustained and there is no evidence of renal injury and no need of recumbency, it is erroneous to assume that trauma is a causative factor in lithiasis. What actually happens in most of these cases is that the patient's attention has been called to pain in the kidney area (renal calculus) which undoubtedly was present prior to the alleged injury and the subsequent train of events. In those states in which aggravation of a preexistent disease is accepted as having causal relevance, the role of trauma in calculosis has become increasingly hard to demonstrate. It is difficult to assume that trauma could aggravate a renal calculus by precipitating movement and migration of a stone. Such phenomena occur without trauma and often are desirable for the ultimate passage of a stone, particularly if the stone is less than 1 cm. in diameter.

When an injury has been of sufficient force to produce hematuria, the interpretation of urolithiasis from a medicolegal point of view must be carefully evaluated after full consideration of all facts. I have repeatedly emphasized the definite increase in the number of complications occurring as an aftermath of traumatic renal injuries. Renal and perirenal tissues may undergo certain changes as a result of trauma. These changes may produce obstructive uropathic change on the side involved and may, with regard to urolithiasis, be sufficient to be the causative, if not the precipitating, factor. Surely, no one can deny that a blood clot or traumatized epithelium may serve as the nucleus for a stone. If the many theories advanced with regard to urolithiasis are to be accepted, the industrial physician must consider all these possibilities when evaluating the condition of an industrial worker who presents a clinical picture of renal stone after severe injury to the kidney. The industrial physician must also take into consideration another aspect of the relation between injury and renal calculus, viz., that a calculus may exist for a long time without producing any symptoms (the so-called silent stone). Such a kidney, if subjected to trauma, may immediately display symptoms of nephrolithiasis not present prior to the alleged injury. This is in marked contrast to nephrolithiasis occurring as a result of a severe injury to a normal kidney. Under such circumstances there will be a considerable lapse of time (weeks, months or years) between the development of the calculus and the onset of symptoms referable to the calculus. This has been clearly demonstrated in many cases observed by myself, in which a kidney already containing stones and subjected to trauma immediately presented clinical symptoms of stone. This is another example of the importance of proper evaluation of the sequence of time or the train of events which in themselves may be *prima facie* evidence that the disease antedated the injury.

In all cases of renal injury and suspected renal trauma it is important to evaluate the degree of renal damage as accurately as possible. Such investigation, in addition to accurate diagnosis, enables one to guard against subsequent infections, deformities and disorders of the kidney, as well as diminish the liability of urolithiasis.

Kidney Stone: Did a Reasonable Length of

Time Elapse for Development of a Pathologic Process?—CASE 1: A 58-year-old white man, an apartment house superintendent, stated that he slipped on a flight of steps, striking his back and left side on the steps as he fell. He continued with his work. Twenty-four hours later, while at work, he felt a sudden pain in the region of the left kidney, so severe that he was nauseated, dizzy and "faint-like." On the following day (forty-eight hours after the alleged injury), he noticed blood in the urine.

His family physician referred him to a urologist, whose investigation revealed a calculus more than 1 cm. in diameter in the terminal portion of the left ureter.

The patient stated that, prior to the date of the alleged injury, he had no pain or discomfort referable to either kidney. At no time did he have frequency or urgency of urination, dysuria, pyuria, nocturia or hematuria. Since the date of the alleged injury, according to the patient, he had urinated about every ten to fifteen minutes during the day with burning, urgency and nocturia (three or four times).

Request was made for authorization of an operation, since the accident had been established and a causal relation was claimed.

Opinion.—In my opinion, the left ureteral calculus was not causally related to the alleged injury. The calculus was unquestionably present at the time of the alleged accident and was coincidental. *A calculus could not form within twenty-four to forty-eight hours.* The episode of severe pain, produced by movement of the stone in the ureter, would have occurred regardless of the alleged injury. There was no aggravation of a preexisting disease.

Renal Calculus: Factor of Immobilization.—CASE 2: A 27-year-old white man was admitted to the hospital because of fracture of the right tibia. He was placed in a walking cast and discharged from hospital but was readmitted within one month with diagnosis of pneumonia of the left lower lobe. He was discharged, but was admitted a third time with a diagnosis of left pleural effusion. It is of singular interest that on the first and second admissions microscopic urinanalysis revealed no abnormal cells but on the third admission showed occasional red blood cells and four or five pus cells per field.

The patient returned to work six months after the date of the alleged injury. After being at work for approximately ten days he first noticed gross blood in the urine. Cystoscopic study and retrograde pyelograms revealed a small calculus in the lower calyceal system of the left kidney. The patient refused operation and resumed his work. He was free of pain for about four months, after which he had an attack of left renal colic. Pyelographic studies now showed the stone in the left ureter, at the level of the left transverse process of the third lumbar vertebra. The opaque shadow on the first films measured 7 mm. in its greatest diameter; 9 mm. was its greatest diameter on the last plates taken.

Opinion.—The aforedescribed ureteral calculus was causally related to the fracture of the left tibia, complicated by left lobar pneumonia and left pleural effusion. The prolonged immobilization was sufficient to produce a calculus. The absence of red blood cells and white blood cells in the urine on the first and second admissions to the hospital and the positive observation of these cells on the third admission appear in logical chronologic order. It is probable that the calculus was forming during this time.

Renal Trauma; Aggravation of a Preexisting Disease.—In all cases of renal injury and suspected renal trauma, it is essential to evaluate as accurately as possible the degree of renal damage. It is extremely important for the industrial physician to realize that when trauma has been insignificant or comparatively mild, and the injured person nevertheless presents signs and symptoms of a renal injury, a search should be made for underlying renal disease. Coincidental pathologic conditions, when they exist, should not be accepted as the explanation of personal injury sustained. *The diseased kidney is more prone to rupture than the normal kidney,* especially if trauma plays a role. In all cases of traumatic renal damage, the possibility of a preexisting disease must be considered. The most frequent of these are: Congenital anomalies (Case 3), hydro-

nephrosis, caluclosis, neoplasm, infection of the kidney, particularly tuberculosis, hemangiomas and nephritis.

CASE 3.—A 66-year-old-white man stated that he had been struck by an angle iron on the left side, in the region of the left kidney. Immediately after the alleged injury, gross hematuria developed. He was admitted to a hospital, where excretory urographic study failed to demonstrate any renal function on either side. Blood chemistry studies showed elevated values for nonprotein nitrogen and urea nitrogen; repeated urinanalyses showed a persistently low specific gravity with abundant albumin, numerous pus cells and many red blood cells per high power fields. The patient was examined cystoscopically and both ureteral orifices catheterized. Indigo carmine, injected intravenously, was not excreted from either side after thirty minutes. Retrograde pyelograms revealed incomplete filling of the calyceal systems on both sides. Diagnosis: bilateral congenital polycystic disease of the kidney.

Comment.—The prognosis in cases of this type is poor. This patient is definitely disabled and cannot engage in his former occupation. There is, however, no causal relation between his present condition and the alleged injury. The cause of polycystic disease of the kidney is purely embryologic and can in no way be due to a trauma such as that described in this man's history. The pathologic condition antedates the alleged injury and has no causal relation to the alleged trauma precipitating a transitory hematuria. Persons with polycystic congenital disease of the kidney may have episodes of hematuria without any history of a fall, blow or injury. In fact, the disease is characterized by such episodes of hematuria, coming on without any definite explanation. This eliminates the possibility of aggravation of a preexisting disease. In order that such a possibility might be accepted, the trauma would have had to be more severe, actually causing contusion or laceration of the kidney, with evidence of severe damage to the overlying structures of the left kidney, not demonstrated in this case.

Trauma to Kidney; Significance of Subsequent Follow-Up.—Although there has been a definite lowering of the death rate associated with trauma of the kidney, there has been a definite increase in the complications following such an injury. Those making surveys do not condemn conservative treatment of kidney injuries, but they emphasize the fact that changes in the renal or perirenal tissues do occur as a result of trauma. Such post-traumatic complications as pyelonephritis, hydronephrosis and pyonephrosis can be guarded against by adequate follow-up.

The industrial urologist must consider these possibilities when investigating an industrial worker who, with a history of renal trauma, complains of a chronic pain in the region of the formerly traumatized kidney. Such a complaint should not be erroneously attributed to neurosis, malingering or other possibilities that actually play no role in the manifestation of pain. It would be more advantageous, as is demonstrated in the following case report, to offer the patient in such a case a complete urologic check-up and determination of the exact present status of the previously injured kidney.

CASE 4.—A 56-year-old white man stated that while he was crossing a wooden ramp the boards of the ramp came apart, causing him to fall and strike his back against the boards. On the following day he felt severe pain in the lower sacral region and on two occasions noted blood in the urine. One week later, roentgen examination of the lumbosacral portion of the spine and the sacroiliac joints revealed no osseous disturbances other than minimal hypertrophic changes arising from the anterior margins of the bodies of the fourth and fifth lumbar vertebrae and calcification within the walls of the abdominal portion of the aorta, due to arteriosclerosis. Three months after the date of the alleged injury the patient was finally seen by a urologist, who expressed the opinion that the patient had probably sustained a contusion of the left kidney. "He may also have a perirenal hematoma (unresolved) at the lower pole of the kidney, because the left ureter seems to be

displaced mesially. I believe this patient should be treated conservatively."

Twelve months later the patient was referred to me because of diurnal frequency of urination (six to twelve times) and nocturnal frequency (three to seven times). He denied diminution of the urinary stream, either in force or caliber, but admitted that he occasionally felt some burning on urination. Prior to the date of the alleged injury, the patient stated, he had never had urgency, frequency, dysuria, pyuria or nocturia. At this time he complained of pain in his back in the region of the left kidney. This pain did not radiate anteriorly to the abdomen, along the course of the ureter, but did radiate posteriorly downward to the left sacroiliac articulation. He also stated that he had noticed some blood in the urine about three weeks before, but that it had not reappeared.

Complete urologic investigation, including retrograde pyelographic study, showed definite pyelectasis and caliectasis on the left side. The urine from the left kidney was cloudy and contained numerous pus cells. Cultures revealed gram-negative coli of the Escherichia group. There was a definite narrowing at the ureteropelvic juncture, which was believed to be the cause of the dilatation above. This narrowing was undoubtedly the result of cicatrization following the resolution of the hematoma (traumatic) and capable of response to dilatation. This anatomopathologic condition could have been prevented by earlier diagnosis and treatment.

Renal Calculus; Occupational Exposure.—CASE 5: A 33-year-old white man employed by the United Nations in the capacity of a deputy secretary stated that while in India he had an attack of left renal colic. There was no history of a direct or indirect injury, blow or fall. Prior to his leaving the United States, a physical examination performed by his physician revealed no abnormalities. A routine urinanalysis at this time was reported as giving normal results.

The first attack occurred in India. He had had similar attacks while in Greece, Switzerland and France. On returning to the United States he was referred to a urologist, who, by cystoscopic and pyelographic studies, demonstrated a stone in the lower third of the left ureter. Since there was pouting of the left ureteral orifice, and since the diameter of the stone on the roentgen film appeared to be less than 1 cm., it was believed that this stone would be passed. The patient was referred to me, and on cystoscopic study I observed no evidence of stone in the left ureteral orifice. A No. 5 roentgen catheter passed on each side without difficulty, meeting no obstruction. Roentgen examination with the catheters left in place failed to show an opaque shadow in either side of the urinary tract. It is probable that if a stone had existed it had passed, although the patient could not recall having passed a stone.

Comment.—It was my opinion that a causal relation no longer existed, as the factors usually considered in stone formation had long since exhausted themselves, and the patient had reached the *status quo ante*. In this case it was difficult to designate an earlier causal relation, since the exact cause of stone formation is uncertain. Among the etiologic factors usually considered are: (1) climatic conditions (as in India), resulting in concentration of urine and deposition of crystals, (2) dietary imbalance and (3) the type of water supply, its availability and consistency. These may have been vital factors in the case just described.

Post Hoc, Ergo Propter Hoc; (After It; Therefore Because of It).—It is extremely important for the industrial physician to realize that, when trauma has been insignificant or comparatively mild and the injured person presents signs and symptoms of a renal injury, careful investigation for an underlying renal disease is imperative. Any coincidental disease that may exist should not be accepted as an explanation of the personal injury sustained. With the occurrence of an injury, even if mild and only temporarily disabling, combined with the ultimate recognition of a serious disease, such as cancer, requiring prolonged medical care, it is only natural for the injured person to state truthfully that he was well before the accident and has been continuously ill since the accident. For some unexplained reason there is a tendency for injuries to occur at the site of neoplastic disease. Ewing called this predisposition "trau-

matic determinism" and stated that "traumas reveal more malignant tumors than they cause." Pack and others feel that when an injury occurs to a part of the body containing a recognized tumor it may be actually beneficial to the patient, as it sometimes leads to the discovery of the tumor while cure is still possible. It is always well to remember that whenever an apparently trivial injury is said to have produced some peculiar and exaggerated effect, and a tumor is later discovered, the tumor probably antedated the injury. This is demonstrated in Case 6:

CASE 6.—A 69-year-old white man stated that, while going down the stairs in a car lubrication pit, he slipped and injured his right side, in the region of the right kidney. Because of progessive pain and inability to walk he was given immediate hospitalization. Roentgen examination of the spine revealed an osteolytic lesion of the first lumbar vertebra. Because of the possibility of prostatic cancer (prostate age) and the fact that an osteolytic lesion is metastatic, urologic consultation was requested. This revealed no evidence of malignant change in the prostate, and all tests confirmed the benignity of the prostatic enlargement that was present. With hospitalization and immobilization, voiding became increasingly difficult and was followed by retenton of urine, which was treated with an indwelling Foley catheter. Studies of the upper portion of the urinary tract were then made by excretory urographic investigation. This definitely revealed enlargement of the left kidney with changes in the renal architecture characteristic of neoplastic renal disease (left side).

Comment.—This case is of interest because the fall revealed the osteolytic lesion, which in turn aroused suspicion of cancer elsewhere. This was determined to be in the left kidney. The fall and blow were on the *right* side, so there could have been no aggravation of a preexisting disease by the fall, and the fall was not severe enough to traumatize the renal or the perirenal tissues. The benign prostatic hypertrophy existed prior to the date of the alleged injury and was definitely aggravated by immobilization. Had this patient been subjected to prostatectomy, it could have been said to be causally related to the alleged injury. This was not true of the carcinoma.

Contusion of Kidney versus Tumor of Kidney.—In most industrial injuries in which renal trauma results from a fall of a short distance or from a light blow or concussion over the kidney, the injury may consist only of a limited rupture of the renal cortex and may have no serious consequences. Such injuries are characterized by pain and hematuria, often observed only microscopically. Retrograde pyelograms may show a change in density, making it hard to arrive at a differential diagnosis between hematoma and tumor. This is demonstrated in the following case.

CASE 7.—A 65-year-old white woman stated that, while about to clean a bathtub, she slipped and fell, striking her left side against the edge of the tub. This was followed by severe pain in the region of the left kidney and left ribs. She noticed that the urine became bloody and remained so for three days. One month after the alleged injury she was still "sore" in the region of the left kidney, but had noticed no blood in the urine and had no urgency, frequency, dysuria, pyuria or nocturia.

A roentgenographic examination of the ribs and urinary tract gave no evidence of any costal fracture, either recent or old. Pyelographic examination of the left side showed an alteration in the morphologic appearance of the primary calyces within the midportion of the left kidney, suggesting the presence of a mass in this area. Reexamination in one month was advised, to determine whether these observations were constant. There were two possible assumptions as to diagnosis and causal relation: Assuming that the alteration in the architecture of the left kidney was due to a contusion of that kidney, it would then be logical to assume that the episode of pain in the region of the left kidney, followed by hematuria for three days, was causally related to the alleged injury. However, if a tentative diagnosis of neoplasm of the left kidney could be made, it would then be logical to assume that possible neoplastic disease of the left kidney would not be causally related to the

alleged injury.

One month later this patient was reexamined cystoscopically, and retrograde pyelograms on the left side gave the same results as those observed on the previous examination. Again the calyces in the upper and lower portions of the kidney were normal; the calyces in the central portion of the kidney were elongated. In the absence of a history indicative of renal disease this could be accepted as a normal variation. However, the history did not warrant such an assumption, and reexamination after an interval of time was recommended.

Three months later patient was rechecked. Pyelographic examination of the left side of the urinary tract showed no dilatation of the pelves or calyces. There was no blunting or deformity of the minor calyces. The observations noted in the two previous examinations were no longer apparent. There were no changes indicative of a mass within the left kidney.

The diagnosis of contusion of the left kidney, now healed, was definitely confirmed. The episode of pain in the region of the left kidney, followed by hematuria for three days, was decided to be causally related to the alleged injury.

Renal Trauma.—CASE 8.—A Negro aged 33 stated that he had fallen from one floor to the one below (under construction), the fall resulting in a fracture of the right arm and injury to the head, face, abdomen and left knee. He was immediately hospitalized. On admission, urinanalysis revealed no abnormal elements in the urine and there was no history of hematuria, urgency, frequency, dysuria, pyuria or nocturia. twelve days after the date of the alleged injury it was first noticed that the patient was passing bloody urine and that he had to urinate four or five times during the day and every hour at night.

Since he showed no evidence of massive bleeding or retention of nitrogen, the results of blood chemistry studies being all within normal range, he was subjected to excretory pyelographic studies. These showed the calyces and pelvis on the left side to be irregular, particularly the left inferior minor calyx. A small amount of dye was observed in the lower pole of the left kidney, separated from the inferior minor calyx by a distance of 1 cm. This was strongly suggestive of an intrarenal tear or injury. Both ureters were partially demonstrated and appeared normal. The urinary bladder filled and emptied well.

Accident notice and causal relation had been established in this case.

Though many of these mild renal injuries subside within a comparatively short time, it is well to bear in mind that too early return to work may cause serious trouble and that bed rest is essential. In many cases of mild renal injuries showing no evidence of hematuria at the time of the alleged injury, these phenomena may become manifest when the patient is ambulatory. This seems to have been borne out in the history of the patient in the aforedescribed case.

Calculosis versus Trauma.—As has been pointed out, traumatic injury frequently calls attention to a calculus that existed prior to the alleged injury. The following case is presented because of definite proof of cause and effect.

CASE 9.—A 44-year-old white man slipped and fell 15 feet from a scaffold, striking the ground on his back. Roentgen examination showed no fractures, and a flat film of the abdomen revealed no opaque shadows in the region of the kidney, ureters or bladder. The patient complained of backache and headache. Five months after the alleged accident, in a flat film, a small shadow was visible (possibly a calculus) in the region of the left kidney. The patient suffered from typical renal colic, and retrograde pyelographic study revealed a stone in the pelvis of the left kidney.

The occurrence of a calculus in the left side of the urinary tract, first demonstrated five months after the date of the alleged injury and not visible in roentgenograms taken immediately after the alleged injury, shows a causal relation. It is quite possible that, as a result of the injury sustained in the original accident, there may have been sufficient damage to the left kidney to cause bleeding and permit the formation of clots, which subsequently served as the nucleus for ultimate stone formation.

Hydronephrosis; Trauma; Death.—CASE 10.—A 62-year-old white man fell from a scaffolding, a distance of approximately 12 feet. He was unconscious and immediately hospitalized. Catheterization (retention) was difficult because of a filiform stricture in the posterior portion of the urethra. The urine obtained was bloody. The patient died within twenty-four hours.

Postmortem examination revealed minimal prostatic hypertrophy; petechiae of the mu-

cosa of the anterior bladder wall were noted. There was a filiform stricture of the posterior portion of the urethra. Bilateral hydronephrosis and bilateral chronic pyelonephritis with multiple areas of abscess formation were demonstrated.

Comment.—This man undoubtedly was in a pre-uremic renal status. This renal damage was the result of the obstruction caused by the urethral stricture, which had probably existed for many years. The slight injury of the bladder mucosa, with blood clot formation and the subsequent acute retention, were sufficient to exacerbate the preexisting pathologic condition; so the train of events that subsequently took place was causally related to the alleged accident.

Intravenous Pyelograms versus Retrograde Pyelograms.—Most urologists will agree that retrograde pyelograms usually provide more precise information than the excretory type, more commonly called "intravenous pyelograms." This is well demonstrated in the following case:

CASE 11.—A young white man stated that, while going down the steps to a locker room, he slipped and, in trying to regain his balance, strained his back. After this he noticed blood in the urine, which lasted for about three days. Subsequent urinanalysis on three occasions showed red blood cells in the urine. He also complained of pain in the back, in the region of his right kidney.

Because of this history he was sent to a nearby hospital for an intravenous pyelogram. The report of this pyelogram stated, "There is no localized deformity, but a general suggestion of 'scalloping' is present on both sides. This is suggestive of *minimal polycystic disease.* No stones were found in the course of either ureter. Retrograde pyelograms suggested."

Urographic examination by the retrograde method showed complete filling of the renal sinus on the right and left sides, with no morphologic alterations. There was no evidence to substantiate a diagnosis of polycystic disease of the kidneys.

Tuberculosis; Bilateral; Causal Relation.—The following case is presented because of the significant train of events and the subsequent interpretation:

CASE 12.—A 45-year-old white woman employed at a tuberculosis sanatorium had frequency of urination, and a diagnosis of left renal tuberculosis was made. Since she had presumably been exposed to patients with tuberculosis, accident and causal relation had been established. She was given a course of conservative treatment, without success, and a left nephrectomy was performed. After this operation the patient made an excellent recovery and was free of all symptoms for six years. Urgency, frequency, dysuria, and microscopic hematuria and pyuria then developed.

Intravenous pyelograms showed the middle calyx of the right kidney to be blunted and typical of early tuberculous calyceal involvement. Subsequent guinea pig innoculation gave positive results for tubercle bacilli. During the interval between the patient's first operation and the subsequent involvement of the opposite kidney, streptomycin therapy for renal tuberculosis became better understood and more readily available. She was accordingly admitted to the hospital for institutional care and administration of streptomycin in conjunction with para-aminosalicylic acid therapy. The temperature remained normal; frequency, urgency and other bladder symptoms lessened, and pyelographic comparative studies indicated no further extension of the lesion in the middle calyx of the right kidney, previously described.

The question that now arose was the determination of a causal relation between the present condition of the right kidney and prior condition of the left kidney. Since accident and causal relation had been established with regard to the tuberculosis of the left kidney, it could not be denied that the same causal relation existed as far as the right kidney was concerned. It seemed reasonable to assume, and probably was testified, that a history of exposure, particularly repeated exposure, of a patient with tuberculosis, might properly be held to be exciting cause of the lesion. In cases of direct injury, such as a blow, fall or contusion, it is usually assumed that, if a focus of infection (tuberculosis) exists, injury may cause it to flare up and bring it to attention clinically, a lesion already

existing in the kidney. Even when a lesion is not already in existence in the kidney, it has been assumed that an injury to an entirely normal kidney may lower its resistance to tuberculosis, so that tubercle bacilli circulating in the blood stream at the time may localize in the kidney.

Mimicry of Symptoms; Evaluation of Character of Pain.—The character of the pain associated with urologic disorders is paramount and often in itself is diagnostic. Because of mimicry of symptoms, particularly with regard to pain, the manifestations of pain may complicate the problem of differential diagnosis. However, the mimicry of disease is never perfect; it is misleading only to the unwary. In all instances the presence of abdominal pain or back pain should arouse suspicion of a lesion of the urinary tract. Investigation of this tract is imperative whenever there is any doubt concerning an intra-abdominal lesion, particularly with regard to appendicitis. Diseases of the kidneys and ureters frequently produce abdominal symptoms, resembling those of diseases of the stomach, the gallbladder, the spleen, the liver and even the pancreas. Similarly, lesions of the lower part of the urinary tract may be confused with appendicitis, intestinal obstruction and (in the female) inflammatory diseases of the tubes and ovaries. The most typical pain in the kidney area is that spoken of as renal colic. This is a sharp or cutting pain that starts posteriorly over the kidney and radiates anteriorly downward along the course of the ureter. It is most frequently caused by a calculus or by any pathologic process that obstructs the ureter and renal pelvis, such as a small blood clot, inspissated pus, metabolic débris (urates), kinking at the ureteropelvic juncture owing to constriction by aberrant blood vessels or fibrous bands, or by the kinking in a ptotic kidney. Metabolic débris in cases of gout in the form of urates is not an uncommon cause of renal colic.

CASE 13.—A white man aged 39, had suffered repeated attacks of renal colic on the right side. He had formerly undergone bouts of gout. Several excretory urographic studies failed to reveal any pathologic change in the urinary tract, but on cystoscopic examination multiple uric acid crystals could be seen pouring from the right ureteral orifice.

CASE 14.—A 29-year-old white man complained of severe pain in the right lower abdominal quadrant. The pain radiated from the kidney area downward and medially to the right groin and testicle. These symptoms had begun about three days before, at which time urinalysis performed by the patient's physician produced microscopic red blood cells. A similar episode of pain had occurred about ten days previously. On examination a positive Murphy sign was elicited over the right costovertebral angle. Because of these findings the patient was referred to the hospital for complete urologic investigation. Cystoscopic and retrograde pyelographic studies revealed no abnormalities of either side or genitourinary tract.

Because of persistent high temperature, roentgen examination of the chest was undertaken, and this too showed no disease. On admission there was a high leukocyte count and the patient now had definite pain over McBurney's point, with muscular spasm and rebound tenderness. Laparotomy exposed gangrenous retrocecal appendicitis which had set up ureteritis, producing mimicry of symptoms as described above.

Horseshoe Kidney; Preexisting Disease.—Anomalies are more commonly seen in the upper part of the urinary tract than in any other system of the body. The reported evidence would seem to indicate that about 40 per cent of all pathologic conditions of the kidneys and ureters originate in congenital anomalies. Although the existence of an anomaly does not necessarily mean the presence of some pathologic lesion with definite clinical symptoms, all are agreed that any congenital abnormality of the urinary tract is potentially a clinicopathologic entity that sooner or later may become a surgical problem. A congenital abnormality such as a horse-

shoe kidney is important rather by reason of its complications than on its own account. The possessor of such an anomaly will sooner or later show symptoms of pain and discomfort due to some associated pathologic conditions favored by pelvic dilatation, urinary stasis and subsequent infection.

CASE 15.—A restaurant manager aged 47 had a past history unimportant until one day, when he lifted a basket of oranges and experienced severe pain in his lumbosacral region. This was followed by severe pain in the left kidney. He received diathermy treatment of the back, but no attention was given to the urinary tract until he suddenly passed several small urinary concretions. About one month later he suffered from severe, sharp piercing pain in the region of the right kidney. At no time did he notice blood in the urine, but repeated urinanalyses revealed microscopic hematuria. He was now voiding about every two hours during the day and three to four times at night.

On his admission to the hospital for urologic study, cystoscopic investigation showed chronic cystitis, Grade I, a patent left ureter and an obstructed right ureter. A left pyelogram revealed marked dilatation of both major and minor calyces, and caliectasis with rotation. The possibility of a horseshoe kidney was considered, but the patient would not consent to further study and evaluation.

He was readmitted to the hospital four months later for horseshoe kidney. During the interim he repeatedly refused cystoscopic manipulation. He still complained of severe backache, more marked on the right side than on the left. A second pyelographic study was made by the excretory urographic technic, which revealed horseshoe kidney with bilateral hydronephrosis, more marked on the left side. Several calcareous deposits were visible in the lower portion of the right kidney.

A symphysiotomy (section of the isthmus) was performed, and he went back to work. There was no return of symptoms referred to the back although roentgenographically there was little improvement in the bilateral hydronephrosis. There could be no causal relation between the alleged accident and the horseshoe kidney, as horseshoe kidney is congenital. There was no aggravation of a preexisting disease, since the train of events would have followed regardless of the alleged injury sustained by lifting a basket of oranges.

SUMMARY

Thirteen cases are presented (1) as an aid in diagnosis, (2) as an aid in interpretation of the medicolegal status and (3) as an aid to better understanding of the industrial worker. The cases are arranged so that the reader may assume and accept the diagnosis and opinion with regard to causal relation, extent of disability and treatment recommended.

RÉSUMÉ

Treize cas sont présentés, ayant pour but:

1. d'aider au diagnostic;
2. de faciliter l'interprétation du status médico-légal;
3. d'arriver à une meilleure compréhension des travailleurs de l'ndustrie.

L'auteur passe en revue les causes, le diagnostic, l'incapacité et la thérapeutique.

CONCLUSIONES

Se comunican 13 casos: (1) como ayuda en el diagnóstico, (2) como ayuda en la interpretación del estado médicolegal y (3) como ayuda al mejor entendimiento del trabajador industrial. Estos trabajos han sido dispuestos de manera que el lector pueda asumir y aceptar el diagnóstico y opinión con relación a la causa, extensión de incapacidad y tratamiento recomendado.

CONCLUSIONI

Vengono presentati 13 casi che possono servire di aiuto 1) alla diagnosi, 2) all'interpretazione dei quesiti medico-legali, 3) ad una maggior comprensione delle malattie professionali.

I casi sono stati scelti in modo da consentire al lettore di rendersi conto della diagnosi, dei rapporti causali, del grado di inabilità consecutiva e della cura.

SCHLUSSFOLGERUNGEN

Es wird über 13 Krankheitsfälle mit urologischen Problemen berichtet. Das Ziel der Arbeit ist, einen Beitrag zur Diagnostik, zur Deutung gerichtsmedizinischer Fragen und zum besseren Verständnis der Probleme des Industriearbeiters zu liefern. Die Darstellung der Fälle erfolgt in einer Weise, die dem Leser gestattet, eine Diagnose zu stellen und sich von den ursächlichen Zusammenhängen, vom Umfang der Invalidität und von der einzuschlagenden Behandlung eine Vorstellung zu machen.

Everyone knows what it is to start a piece of work, either intellectual or muscular, feeling stale—or *cold*, as an Adirondack guide once put it to me. And everybody knows what it is to "warm up" to his job. The process of warming up gets particularly striking in the phenomenon known as "second wind." On usual occasions we make a practice of stopping an occupation as soon as we meet the first effective layer (so to call it) of fatigue. We have then walked, played, or worked "enough," so we desist. That amount of fatigue is an efficacious obstruction on this side of which our usual life is cast. But if an unusual necessity forces us to press onward, a surprising thing occurs. The fatigue gets worse up to a certain critical point, when gradually or suddenly it passes away, and we are fresher than before. We have evidently tapped a level of new energy, masked until then by the fatigue-obstacle usually obeyed. There may be layer after layer of this experience. A third and a fourth "wind" may supervene. Mental activity shows the phenomenon as well as physical, and in exceptional cases we may find, beyond the very extremity of fatigue-distress, amounts of ease and power that we never dreamed ourselves to own,—sources of strength habitually not taxed at all, because habitually we never push through the obstruction, never pass those early critical points.

For many years I have mused on the phenomenon of second wind, trying to find a physiological theory. It is evident that our organism has stored-up reserves of energy that are ordinarily not called upon, but that may be called upon: deeper and deeper strata of combustible or explosible material, discontinuously arranged, but ready for use by anyone who probes so deep, and repairing themselves by rest.

—*William James*

Ovarian Pregnancy

WILLIAM JAMES MOORE, C.St.J., F.R.F.P.S., M.C.P.S.*
AND
JOHN FORREST-HAMILTON, K.St.J., M.D.**
GLASGOW, SCOTLAND

OF the many causes of intra-abdominal hemorrhage, extrauterine pregnancy, with its complications, is perhaps the most elusive to diagnosis, although it may well be much less rare than was formerly supposed. Certain reliable syndromes help in the somewhat difficult diagnosis of what may be termed a veiled ectopic gestation.

The first description of ovarian pregnancy has been variously ascribed to Mercer[1] and to Maurice[2] in 1682. In 1878 Spielberg[3] described the condition, while Tussenbrock[4] is credited with the first histologic description in 1899. During the present century many writers have added to the general knowledge of extrauterine pregnancy.

The case to be described emphasizes the importance of considering the possibility of ectopic gestation in women of the reproductive age, although the usual signs of such a condition may be absent.

Incidence.—Ectopic gestation is most common in multipara and often follows a period up to ten years of sterility. Rogue[5] stated that it occurs most frequently near the end of the childbearing period. The ovarian type is the rarest and has been stated by Isbell and Bacon[6] to occur only once in every 25,000 pregnancies. Ganz and Ennis[7] estimate that it forms less than 1 per cent of all extrauterine pregnancies.

It may well be that if all ectopic pregnancies were microscopically investigated the incidence of the ovarian type might be discovered to be much less rare than these figures would indicate. It may be that it would explain cases of ovarian hemorrhage which are encountered from time to time but have escaped recognition.

Etiologic Factors.—The cause of extrauterine gestation is still shrouded in mystery. Physiologists have shown experimentally that fertilization occurs in the fallopian tube and that the ovum is then propelled into the uterus by the cilia lining the tube. Any obstruction of the lumen may cause the ovum to develop or to remain undeveloped in the tube, or to be expelled outward to form an ovarian or an abdominal pregnancy. Intrauterine and extrauterine pregnancies may develop simultaneously, as happened in the case to be reported.

It would appear that the possible causes might be classified as congenital and acquired. Congenital conditions of the tube may be kinks, diverticula or stenosis, or there may be a deficiency in the cilia and the mucous lining. Freund and Frommell[8] attached importance to narrow, tortuous tubes, and in these cases the possibility of a defective lining cannot be ignored.

Acquired mechanical obstruction may result from retrodisplacement of the uterus, the presence of small tumors, stenosis following inflammation and torsion resulting from adhesions. Although no anatomic or

*Fellow of the Royal Society of Medicine, Formerly Surgeon, Outpatients, Victoria Infirmary, Glasgow; Assistant Surgeon, Royal Samaritan Hospital, Glasgow; Senior Assistant Professor of Surgery, Anderson College of Medicine, Senior Assistant Professor of Anatomy, the Anderson College of Medicine.
**Warden, The Order of St. John Foundation Hospital, Glasgow.
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physiologic difference has been detected in the two tubes, ectopic pregnancy is more frequent on the left side than on the right.

Inflammatory causes may be abortion, endometritis or gonorrheal, tuberculous or puerperal infection. Endometritis has been observed in a number of cases.

Other acquired causes may be prolonged sterility resulting from previous inflammation or glandular deficiency, and, psychologically, fright or profound emotion at the time of conception. In most cases the train of events appears to be as follows: mechanical deformity, inflammation, a period of sterility and an abnormal ovum.

REPORT OF CASE

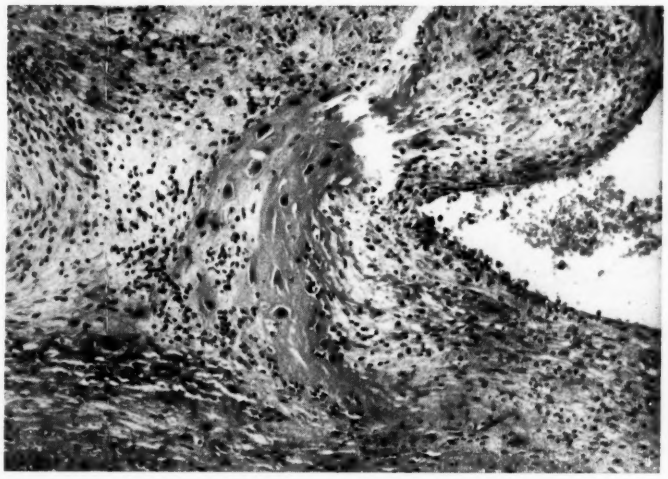
In September 1947, Mrs. F., aged 38 years, complained of intermittent generalized abdominal pain, menorrhagia and loss of weight during the past year. Her previous history was not significant. Menstruation had commenced at the age of 12 and until recently had given no trouble. Three years prior to admission a simple adenoma had been removed from the left breast.

The abdominal pain, which at first recurred about every ten days but was always worse during menstruation, had recently become more severe and of daily occurrence. It commenced at the pit of the stomach and radiated to all parts. Nausea was absent, but the patient felt faint before the onset of the pain, experiencing an urgent desire to micturate. She ate well, and as a rule her sleep was not disturbed.

Of blond complexion, she looked older than her years; she was underweight and pallid. The breasts were large and firm and showed dilation and prominence of the superficial veins. The suggestion of an early pregnancy was further confirmed by a decrease in the general translucency of the glands on transillumination.

The skin of the abdominal wall was normal, but there was resistance on pressure over the muscle of the left iliac fossa. The uterine fundus was palpated at the symphysis pubis as in a three months' pregnancy. A mass, about the size of a small orange and having the clinical characteristics of an ovarian cyst, was felt in the left iliac region, where the percussion note was slightly dull and the peristaltic movement sluggish.

Examination *per vaginam* revealed a patulous and eroded cervix and a soft, enlarged uterus. A subserous fibroid about the size of a hen's egg occupied a site near the fundus. What was taken to be a left ovarian cyst was



Photomicrograph, × 120, taken in case of extra-uterine pregnancy (see text).

freely mobile, soft, fluctuant and tender on pressure. The pouch of Douglas and the rest of the pelvic cavity presented no abnormality.

Wassermann and Kahn tests gave negative results. The blood picture showed no abnormal cells. The white cell was normal, but there was a slight decrease in the number of red cells.

A diagnosis of intrauterine pregnancy, complicated by a subserous pedunculated fibroid and a left-sided ovarian cyst, was made, and operation was performed through a transverse incision by the electrosurgical technic. The advantages of these methods have been fully described in previous papers, but in a case of this kind the benefit of the free exposure given by the transverse incision must be obvious. At operation the clinical impressions were confirmed, except that the left ovary was very dark and was adherent to the omentum. The fibroid was removed and a left salpingo-oophorectomy performed. With the exception of a slight vaginal hemorrhage, which persisted for only twenty-four hours, convalescence was uneventful. The patient was dismissed well on the thirteenth day after the operation.

Pathologic Picture.—To justify a diagnosis of ovarian pregnancy the tube, including its fimbriated extremity, must be shown to be intact and separate from the ovary; the gestational sac must occupy the normal position of the ovary and be connected with the uterus by the utero-ovarian ligament, and ovarian tissue must be demonstrated in the walls of the sac.

The ovary removed in this case was enlarged, measuring 2 by 1½ by 1½ inches (5 by 3.7 by 3.7 cm.). Several simple cysts of the follicular type were present, but the enlargement was mainly due to a cyst, 1 inch (2.5 cm.) in diameter, containing chocolate-colored material surrounded by hemorrhagic walls. The fimbriated end of the tube, though lightly adherent, was not involved in the cyst.

Microscopically, lutein cells were observed in the ovarian stroma, while the stromal cells toward the surface of the gland appeared to have undergone a decidual change. The large cyst contained a mass of blood clot, embedded in which were typical, though almost completely necrotic, chorionic villi. The ovary was definitely demonstrated to be the seat of the dead product of an ectopic gestation. Organization was present on one side, and the ovarian tissue was extensively involved in the pregnancy.

COMMENT

This case presents some interesting features and problems. In a case of dual pregnancy the Aschheim-Zondek test gave a negative result, and none of the classic signs of ectopic gestation was present. The condition was not suspected prior to operation. The case suggests the wisdom of keeping in mind this possibility in the treatment of every pelvic lesion occurring in a woman of childbearing age, especially in the latter part of the period.

The tumor of epithelial origin of the mammary gland, the mesoblastic tumor of the uterus and the coexisting intrauterine and extrauterine pregnancies raise the interesting speculation of a predisposition to neoplastic development, possibly due to glandular imbalance.

The causal factors are imperfectly understood, but they may be associated with the greater incidence of pathologic conditions in the left side of the pelvis. Probably the site of implantation of the spermatozoa is a graafian follicle which may be entered directly by puncture or when it ruptures. Fertilization of the egg cell may take place on the surface of the ovary, and the ovum may then invade the ovary by erosion. As development continues, the ovary becomes filled with blood clot containing an amniotic cavity, chorionic villi being present. The capsule is formed by ovarian tissue, while particles of decidual tissue are present in the medulla and in the cortex. The termination is usually rupture unless the ovary is removed in advance of this stage. In cases in which rupture does not occur, a mole may form.

The present case indicates the advantages of certain methods not generally practiced. We have noted in many instances that transillumination is a reliable test for pregnancy and other disturbances of the breast. The transverse incision and the electrosurgical technic offer many advantages over methods formerly used.

SUMMARY

The actual cause or causes of extrauterine pregnancy are not definitely known, but the condition should be kept in mind in dealing with pregnant patients. A case is reported in which intermittent generalized abdominal pain, menorrhagia and loss of weight led to examination and diagnosis. Operation confirmed the preoperative impression, and surgical treatment brought about successful results, the only postoperative complication being slight vaginal hemorrhage for twenty-four hours.

RÉSUMÉ

Les causes de la grossesse extra-utérine ne sont pas encore élucidées, mais il faudrait toujours envisager cette possibilité chez les malades enceintes. Les auteurs rapportent un cas où les syndromes (douleurs abdominales généralisées intermittentes, ménorragie et perte de poids) ont nécessité l'examen de la malade. L'opération confirma l'impression qu'il s'agissait d'une grossesse extra-utérine. Suites opératoires: fiable hémorragie vaginale durant 24 heures.

ZUSAMMENFASSUNG

An extrauterine Schwangerschaft muss bei schwangeren Kranken immer gedacht werden, wenn auch die eigentliche Ursache oder Ursachen der Erkrankung unbekannt sind. Es wird über einen Fall berichtet, in dem das wiederholte Auftreten allgemeiner Bauchschmerzen, Menorrhagie und Gewichtsverlust zur Untersuchung führten und die Diagnose gestellt wurde. Die Operation bestätigte die Diagnose, und der Eingriff führte zur völligen Heilung. Die einzige Komplikation nach der Operation bestand in einer leichten 24 Stunden anhaltenden vaginalen Blutung.

RESUMEN

La causa ó causas actuales del embarazo extrauterino no se conocen en forma definida, pero el padecimiento debe tenerse presente cuando se trata con pacientes embarazadas. Se comunica un caso en el cual un dolor abdominal, intermitente y generalizado, menorragia y pérdida de peso, dieron lugar al examen físico y al diagnóstico. La operación confirmó la impresión preoperatoria y el tratamiento quirúrgico produjo resultados satisfactorios, la única complicación postoperatoria fué una ligera hemorragia vaginal que duró veinticuatro horas.

RIASSUNTO

Le cause della gravidanza extrauterina non sono ancora conosciute, ma questa possibilità deve essere tenuta presente in ogni caso di gravidanza.

Viene riferito un caso in cui si giunse alla diagnosi a causa di dolori addominali diffusi intermittenti, metrorragie e dimagrimento. La donna fu operata con successo e l'unica complicazione post-operatoria fu una lieve perdita ematica dai genitali nelle prime 24 ore.

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Mesenteric Vascular Occlusion

Report of a Case with Resection, Survival and Five-Year Follow-Up

PHILIP LADIN, M.D., F.A.C.S., F.I.C.S.

NEW YORK CITY, NEW YORK

MESENTERIC vascular thrombosis is considered a rare disease. There are reports of occasional cases or small groups of cases, but in 30,000 consecutive admissions to the New Orleans Charity Hospital only 13 cases were encountered.[1] The incidence is generally quoted at about 0.1 percent of all surgical admissions to a general hospital. The condition must be more common than these figures indicate, however, for every surgeon seems to have observed one or more cases of this disease.

The male is affected more commonly than the female, in a ratio of about 3 to 2. The condition may occur at any age but it is most common in persons between 50 and 60. Cardiac conditions, especially fibrillation, are well known to be the cause in some cases. But what is not generally appreciated is that many other predisposing etiologic factors exist; for example, intra-abdominal infection, hernia, adhesions and torsions. Most important, in many cases no cause can be established.

Mesenteric vascular occlusion may be either venous or arterial. In the majority of cases it is arterial.[2] However, venous occlusion is usually followed shortly by arterial thrombosis and vice versa, so that by the time the specimen reaches the pathologist it is difficult, if not impossible, for him to determine which came first. The occlusion may be due to an embolus or a thrombus, but thrombosis seems to be more common according to recent studies. The superior mesenteric vessels account for 90 per cent of cases and the inferior mesenteric for about 10 per cent. Arterial occlusion produces an anemic infarct, especially if it occurs in an already narrowed vessel. Venous occlusion leads to hemorrhagic infarction. At an early stage edema is present, bluish or purplish spots are observed, the serosa is still glistening, and straw-colored fluid is present in the peritoneal cavity. The mesentery is thickened, and black thrombosed cords may be seen or palpated. Later the intestine appears more congested, and finally the overfilled capillaries burst, pouring blood and plasma into the lumen of the bowel as well as into the abdominal cavity. At this stage the peritoneal exudate is, of course, hemorrhagic, the degree depending on the state of the disease. It is this loss of circulating fluid that accounts for the severe picture of shock so often observed in these cases. Eventually the bowel becomes gangrenous. The proximal portion of the bowel is surprisingly little dilated owing to the lack of real obstruction, since this condition represents a non-acting loop rather than a true mechanical obstruction. Because of the many arcades and the rich collateral circulation, the bowel should be able to maintain its viability, but secondary extension of the clot into the adjacent arcades precludes the recovery of the bowel. Although spontaneous recovery has been reported and may occur, it must be regarded as a surgical curiosity rather

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than as a likely occurrence.

The symptoms of the two types of thrombosis are similar, but they are much more dramatic in arterial occlusion. They consist of abdominal pains, cramps, vomiting, diarrhea, gradual abdominal distention which never reaches great proportions, and, possibly, blood in the vomitus or the stool. Shock is present early in cases of arterial occlusions and later in cases of venous occlusions. Peritonitis is a late manifestation. In about 10 per cent of cases a vague, doughy mass may be palpated.

The diagnosis is rarely made preoperatively. Examination of an elderly patient with abdominal pain of sudden onset, mostly left-sided, with little rigidity, moderate abdominal distension and abdominal sounds that are first moderately active, and then absent, producing a silent abdomen, should make one suspicious. A roentgen plate of the abdomen shows dilated loops of small bowel, limited in extent. The combination of a clinical picture suggestive of large bowel obstruction with roentgen evidence of moderate dilation of limited loops of small bowel is highly suggestive of this diagnosis. As with so many conditions in medicine, one must first think of the condition if one is to diagnose it. A high index of suspicion should lead to more preoperative diagnoses.

The treatment of choice is operation, with resection of the involved bowel and its mesentery. This gives the patient his only chance for survival. The amount of bowel that can be successfully resected is amazing, all but 8 inches (20 cm.) of it having been resected with patient surviving.[4] The diarrhea is difficult to control, but it can be managed, and control improves with time. The operative mortality rate is high, ranging from 32.6 to 84 per cent in different reports, with the average about 62 per cent. Treatment with anticoagulants and antibiotics should be reserved for patients who refuse operation or who are deemed hopelessly inoperable. Postoperatively, anticoagulants and antibiotics should be given.

REPORT OF CASE

Mrs. S. S., a 70-year-old white woman, was admitted to Lebanon Hospital on Sept. 25, 1949, with a two-and-a-half day history of severe pain in the left lower abdominal quadrant, followed twenty-four hours after its onset by nausea and vomiting. The pain was aggravated by physical activity and had persisted undiminished since that time. There had been no bowel movements for two days, and no flatus had been passed for the previous twenty-four hours. An enema given at home was "not satisfactory." The past history revealed that this patient had been having recurrent attacks of pain in the left lower quadrant for several months. A right inguinal hernioplasty had been performed in 1917, and an abdominal operation of unknown nature in 1918.

Physical examination on admission revealed an acutely ill, dehydrated patient with sunken eyes, a dry tongue and dry skin. The temperature was 101 F. and the pulse rate 114. The abdomen was distended all over and tenderness was present throughout, most marked in the left lower quadrant and the epigastrium. No rebound tenderness could be elicited, and no masses were palpable. Rectal and rectovaginal examination revealed some tenderness in the cul de sac and on moving the cervix, but no masses were palpated. No feces were observed in the rectum. Laboratory tests revealed 3,350,000 red blood cells per cubic millimeter, with 10 Gm. of hemoglobin, and 15,500 white blood cells, with 83 per cent polymorphonuclears (band cells 30) and 17 per cent lymphocytes. The urine gave a 3 plus reaction for sugar; traces of albumen and of acetone were present, microscopic examination revealed many granular casts. The impression on admission was that this patient had an intestinal obstruction, probably due to neoplasm and possibly due to adhesions. An enema was given and reported as giving no results, neither flatus nor stool being passed. A flat plate of the abdomen was taken, which revealed filled loops of small bowel with fluid levels but no evidence of dilatation of the large bowel. Because of the patient's poor

condition a Miller-Abbott tube was passed and suction was started. She was given intravenous fluids, blood transfusions and large doses of penicillin in preparation for possible surgical intervention. She was again seen five hours later, at which time there was no improvement in either her physical condition or the physical abnormalities. An exploratory laparotomy was deemed advisable.

With the patient under general anesthesia, the abdomen was opened with a right rectus incision. A large number of adhesions were observed. There was also a large amount of dark hemorrhagic exudate in the peritoneal cavity and about 4 feet (121.9 cm.) of black, completely gangrenous bowel with a very foul odor, typical of gangrene. The remainder of the bowel had pinpoint hemorrhagic spots on the mesenteric side. When the bowel was opened for the anastamosis the lumen was seen to be filled with hemorrhagic material. About 4 feet (121.9 cm.) of this gangrenous bowel, together with about 4 inches (10 cm.) of relatively normal intestine on each end was resected, together with its adjoining mesentery, and an end-to-end anastamosis was performed in two layers by the open method. The abdomen was closed in layers without drainage.

Postoperative Course.—The highest postoperative temperature was 101 F., and the patient passed flatus forty-eight hours after the operation. Her convalescence was complicated by superficial thrombophlebitis, which responded rapidly, and by diarrhea. The latter was controlled with moderate difficulty. The wound healed *per primam*, and the patient was discharged home fifteen days after the operation, apparently in good condition.

Pathologic Report.—Gross Specimen: The specimen consisted of a loop of small intestine measuring 95 cm. in length and 3 cm. in diameter. At the proximal and distal ends the bowel was normal in appearance for a distance of several centimeters. The remainder of the specimen was dark purplish red. Attached to the loop was a segment of mesentery; this was bright red, with the appearance of fresh hemorrhage. On dissection, several of the veins are observed to contain fresh, soft, dark red thrombi. Representative sections were taken for histologic examination.

Microscopic Picture: The sections revealed diffuse hemorrhagic infarction of all coats of the bowel and of the fat tissue of the mesentery. Many of the larger veins were filled with fresh thrombi. The remaining blood vessels were strikingly engorged. There was no histologic evidence of organization of the thrombi; however, several vein walls showed early necrosis.

Gross and Microscopic Diagnosis: The diagnosis was hemorrhagic infarction and necrosis of the small intestine, due to thrombosis of mesenteric veins.

Follow-up Examination: This patient has been seen at regular intervals since her discharge, and up to the time of this report has been well and has had no difficulty (four years, and ten months). The diarrhea has subsided, and the patient is well and carrying on normal activities, including her own housework.

COMMENT

Mesenteric vascular occlusion is a dramatic and catastrophic abdominal emergency. It is apparently more frequent then is generally supposed, and recognition of the condition, with immediate surgical intervention, may result in cure. Spontaneous recovery is rare, although cases have been reported in which laparotomy revealed the thrombosis in the superior mesenteric artery and the patient recovered without resection of the lesion. Treatment with anticoagulant therapy is required in all such cases, either instead of surgical intervention or subsequent to it; however, these agents should not be relied upon as the sole method of treatment, if operation is possible. Uricchio, Calanda and Freedman[5] collected all the cases reported in the literature of patients who have survived intestinal resection for this disease. They noted a total of 158 cases, together with the ones they reported. The case here presented will bring the total to 159.

CONCLUSIONS

Mesenteric vascular occlusion is an uncommon but highly significant disease which is amenable to surgical intervention, and the patients can survive resection. Enormous amounts of bowel have been

resected, with survival. The physiopathologic picture of obstruction to the mesenteric blood supply is briefly described. A case of mesenteric vascular occlusion is reported, in which resection of a little over 4 feet (121.9 cm.) of small bowel was performed, with a five-year survival. This brings the total number of reported cases of resection and survival to 159.

CONCLUSIONES

La oclusión vascular mesentérica es un padecimiento raro pero altamente significativo que es tratable por intervención quirúrgica y cuyos pacientes pueden sobrevivir a la resección. Grandes cantidades de intestino han sido extirpadas con supervivencia.

Se describe brevemente la imagen fisiopatológica de la obstrucción, de la vascularización sanguínea mesentérica.

Se comunica un caso de oclusión vascular mesentérica en el que se realizó una extirpación de más de 4 pies (121.9 cm.) de intestino delgado, con una supervivencia de cinco años. Esto hace un total de 159 casos comunicados de resección con supervivencia.

SCHLUSSFOLGERUNGEN

Der Verschluss von Mesenterialgefässen gehört zu den seltenen aber höchst bedeutungsvollen Erkrankungen, die chirurgischer Behandlung zugänglich sind. Die Kranken können die Resektion überleben. Aeusserst umfangreiche Darmresektionen können überstanden werden.

Das physiopathologische Bild der Verstopfung der mesenterialen Blutversorgung wird kurz beschrieben.

Es wird über einen Fall von Mesenterialgefässverschluss berichtet, in dem etwas mehr als 122 Zentimeter Dünndarm reseziert wurden und der Kranke fünf Jahre nach der Operation am Leben war. Damit steigt die Gesamtzahl der veröffentlichten überlebenden Fälle auf 159.

RÉSUMÉ

L'occlusion artério-mésentérique est une affection rare mais sérieuse. justiciable d'une intervention chirurgicale. Les malades peuvent survivre à la résection, malgré les énormes masses d'intestins réséquées.

Brève description de l'image physiopathologique de l'obstruction.

Rapport d'un cas, avec résection de plus de 1,20 m d'intestin grêle. Nombre total des cas rapportés à ce jour, avec résection et survie: 159.

CONCLUSIONI

L'occlusione dei vasi mesenterici è evenienza rara ma assai grave e dominabile chirurgicamente. E' possibile, infatti, sopravvivere a estesissime resezioni intestinali.

Viene esposta la fisiopatologia dei vasi mesenterici e descritto un caso in cui si eseguì una resezione du tenue di 122 cm.

Il paziente sopravvive da 5 anni e va ad aggiungersi ad altri 159 casi favorevoli della letteratura.

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Twenty-Four Hour Neomycin Preparation for Intestinal Operations

LAWRENCE S. MANN, M.S., M.D., F.A.C.S., F.I.C.S.,
WILLIAM SCHUMER, M.D., AND AUGUST TOMUSK, M.D.

CHICAGO, ILLINOIS

NEOMYCIN was isolated by Waksman and Lechavalier[1] in 1949 from a culture of Streptomyces Fradaie. This drug has been used topically for local infections. At present it is being used for intestinal antisepsis, because only about 3 per cent of neomycin is absorbed from the intestinal tract;[2] in addition, the consensus is that resistant bacterial strains rarely develop. The physical and chemical properties have been described by Poth and his co-workers[3] and by Pulaski.[4] Poth[5] set forth requirements for an ideal intestinal antiseptic, most of which are fulfilled by neomycin. The aforementioned authors, however, have been using neomycin in combination with other drugs: Pulaski[4] and Poth,[5] sulfathalidine; Dearing and Needham,[6] terramycin, and Meleney and Johnson,[7] bacitracin. These investigators used the combined antibiotics for a period of at least three days. Since neomycin has already proved to be bacteriocidal or bacteriostatic to the intestinal flora within twenty-four hours, we decided that longer preparation would not be needed and that neomycin in itself would suffice. The following investigation, therefore, was undertaken:

Clinical Material. — Thirty-four cases were studied, 19 of malignant and 15 with benign disease. In the malignant group (in all of which there was some degree of obstruction) the lesions were all carcinoma in various locations in the colon or the rectum. The benign group included hemorrhoids, polyps, closure of colostomy, colectomy, appendiceal fistula and diverticulitis. The average age of the patients was 50; most of them were 60 to 75 years of age, but the ages varied from 13 to 82 years.

Procedure.—Neomycin in itself does not prepare the bowel mechanically, that is, it does not liquefy the stools, and therefore the following procedure was instituted: A low residue diet was prescribed seven days prior to the operation. One teaspoon of phospho-soda solution was given twice a day for one week. In two or three days the patient began to have loose stools. The phospho-soda solution was discontinued when administration of neomycin was begun, which was thirty-six to forty-eight hours before the operation, as we prefer that our patients have an undisturbed night's sleep before the operation. One Gm. of neomycin sulfate by mouth was given hourly to four doses. (With the fourth dose an ounce of phospho-soda solution may be optionally given. Some vomiting may be encountered with the fourth dose of neomycin and phospho-soda, but is of no consequence.) One Gm. of neomycin orally was administered every four hours until a total of 10 Gm. of the drug had been given or a period of twenty-four hours had elapsed since it was begun.

From the Department of Surgery, Chicago Medical School and Mount Sinai Hospital, Chicago.

The neomycin tablets (Mycifradin—®) for this study were supplied by Dr. Harold R. Reames of the Upjohn Company, Kalamazoo, Michigan.

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A sodium bicarbonate enema was given routinely on the night before the operation. A bowel culture in the form of a rectal swab was taken before neomycin was started. An intestinal culture was also done at the time of the operation and daily thereafter for about ten days. Plating was done by the usual methods on eosinmethylene blue media for coliform bacteria and azide blood agar media for enterococci and staphylococci.

Results.—At the time of operation, the large bowel, which had been prepared with neomycin, was contracted and sterile for aerobes, and the mucosa was not irritated. In 17 cases in which neomycin was used preoperatively and no antibiotics were given postoperatively there were no complications, and the postoperative course was smooth. The bowel remained sterile on an average of five and one-half days after the operation, varying from four to ten days.

In a second group, 17 patients were prepared with neomycin and postoperatively were given 400,000 units of procaine penicillin G and 0.25 Gm. each of streptomycin and dihydrostreptomycin sulfates twice daily. Five complications developed in this group, three of which (sterile abscess with obstruction, prostatitis and pulmonary embolus) we do not attribute to the drugs. However, staphylococcus enterocolitis developed, postoperative in 2 cases, which will be reported in this paper. The duration of intestinal sterility was the same as in the first group—an average of five and one-half days, varying from three to more than seven days.

Aerobacter aerogenes was cultured in 3 cases at the time of operation. We were unable to sterilize the bowel with neomycin in 2 cases of hemorrhoids and 1 of ulcerative colitis. If the bowel is prepared with more than 10 Gm. of neomycin there is an overgrowth of organisms, particularly staphylococci. One patient was given a double preparation, and staphylococcic overgrowth was observed.

The cases in which enterocolitis developed after the postoperative administration of penicillin and streptomycin are here reported.

CASE 1.—A white girl aged 13 years had an appendiceal abscess which had developed eight months prior to admission. It was drained. A fistula developed, which did not close during an eight-month interval. The patient was admitted to the hospital and prepared with the usual twenty-four hour neomycin regime as outlined. Postoperatively she was given 400,000 units of procaine penicillin G and 0.25 Gm. of streptomycin and dihydrostreptomycin each, twice daily for five days. On the fourth postoperative day loose stools, diarrhea and excoriation of the buttocks were present. Stool cultures revealed large numbers of Staphylococcus pyogenes. The penicillin, streptomycin and dihydrostreptomycin were discontinued and 800 mg. of erythromycin was given orally in 4 divided doses daily for two days, after which the symptoms subsided.

CASE 2.—A 72-year-old white woman with carcinoma of the rectosigmoid was treated with the same preoperative and postoperative regime as was employed in Case 1. The symptoms of enterocolitis developed on the fourth postoperative day. She was treated with erythromycin, as was the first patient. The symptoms subsided in two days. The cultures were similar.

The symptoms in both cases were itching (pruritus ani), loose stools and sore throat. The clinical signs were red, beefy tongues, inflamed buccal mucosa with some white patches and excoriated red buttocks.

The twenty-four hour neomycin preparation of the bowel for operation has been adequate for sterilization as far as aerobic bacteria are concerned. We did not do anaerobic cultures, as we did not consider it necessary; if the bowel is sterile for aerobes, the anaerobes are unable to become pathogenic without the symbiotic effect of the aerobes. Most complications caused by spillage or leakage are due to the aerobic group of bacteria. All of our anastamoses were done by the open method. The one abscess we encountered was sterile.

The tetracycline drugs were not used

in combination with neomycin preoperatively, since they may cause mucosal ulcerations of the digestive tract, particularly about the suture line. When neomycin is used alone, the healing of the sutured bowel appears to be accelerated and the healing stage of the anastomosis on the third postoperative day appears to progress to a point where it would normally be on the fifth postoperative day. We have had occasion to visualize the suture line, which confirmed this impression. The colon is contracted when prepared with neomycin, and the mucosa is not irritated, which is a desirable state for operations on the large bowel.

Neomycin allows the flora to return in a satisfactory manner, and this commences on the third or fourth postoperative day. In our opinion, antibiotics, given either in conjunction with neomycin or postoperatively, interfere with the return of the flora. This is undesirable, as we have encountered two cases of staphylococcus enterocolitis in the group of patients who were given antibiotics postoperatively. In a pilot study, neomycin was given in combination with oxytetracycline as a part of the preoperative preparation. In this small group, staphylococcic enterocolitis developed in 3 cases. Apparently these other antibiotics interfere with the return of the flora, disturbing the symbiosis and permitting an overgrowth of Micrococcus pyogenes. We are of the opinion, therefore, that neomycin in itself is adequate and that no antibiotic drugs should be given with it, either preoperatively or postoperatively, except when indicated. A sixteenth requirement should be added to those of Poth[8] for an ideal intestinal antiseptic; the drug should not interfere with the return of the flora.

We have observed no untoward effects, complications or undesirable features that we can attribute to neomycin. Occasional nausea and vomiting were observed, which readily subsided and presented no indication for discontinuance of the drug. The bowel can be adequately sterilized in most instances with 9 or 10 Gm. of neomycin over a twenty-four hour period. In fact, we are convinced that a smaller amount of the drug would be satisfactory and experiments with a smaller dosage are now under way. The smallest amount of a bacteriocidal or bacteriostatic agent should be used which will sterilize the bowel for an adequate period and will not interfere with the return of the flora. The return of the flora does not interfere with healing and may even enhance it. This was vividly illustrated in a patient who was given 10 Gm. of neomycin after biopsy of a lesion in the rectosigmoid. Ten days later he was operated upon, again being prepared with 10 Gm. of neomycin. The culture taken at the time of operation showed an overgrowth of staphyloccoccus, which was not observed after the first administration of the drug.

Our experiments indicate that a great deal of hospital time can be saved with this drug, reducing the number of days in the hospital for each surgical procedure, making more beds available and, in the last analysis, involving considerably less expense for the patient.

CONCLUSIONS

1. Neomycin alone is a satisfactory adjunct in preparing the bowel for operation.

2. Neomycin in itself does not prepare the bowel mechanically (i.e., it does not liquefy the stools).

3. Antibiotics should not be used routinely in the postoperative management of patients undergoing intestinal operations after preparation of the bowel with neomycin.

4. The bowel is sterile for aerobic bacteria with the twenty-four neomycin regime at operation and, on the average, for five and one-half postoperative days, but this sterility may be maintained for

three to ten days.

5. The postoperative use of penicillin and streptomycin does not increase the average duration of intestinal sterility and may interfere with the return of the flora.

6. Preoperative hospitalization is diminished by use of the twenty-four hour neomycin regime.

RESUMEN

1. La neomicina sola es un axiliar satisfactorio para la preparación intestinal preoperatoria.

2. La neomicina no hace por sí misma la preparaciôm mecánica del intestino (v.g. no licúa las evacuaciones).

3. No deben usarse rutinariamente antibióticos en la atención postoperatoria de pacientes intestinales operados cuyo intestino haya sido preparado con neomicina.

4. El intestino es estéril en lo que atañe a las bacterias aerobias con el método de veinticuatro horas de neomicina preoperatoria y por término medio, durante cinco y medio diás postoperatorios pero dicha esterilidad puede mantenerse de tres a diez días.

5. El uso postoperatorio de penicilina y estreptomicina no aumentan la duración media de esterilidad intestinal y pueden impedir el retorno de la flora.

6. El método del uso de neomicina por veinticuatro horas disminuye la hospitalización preoperatoria.

RIASSUNTO

1. Soltanto la neomicina dà risultati soddisfacenti nella preparazione dell'intestino agli interventi.

2. La neomicina non prepara, di per sè stessa, l'intestino agendo meccanicamente (non rende, cioè, le feci liquide).

3. L'uso degli antibiotici non è sempre necessario nella cura post-operatoria dopo interventi sull'intestino, quando, per la preparazione, sia stata usata neomicina.

4. Con un trattamento di neomicina protratto per ventiquattro ore, l'intestino è privo di batteri aerobici all'atto dell'intervento e, in media, per cinque giorni e mezzo dopo—ma tale sterilità può mantenersi dai tre ai dieci giorni.

5. L'uso post-operatorio di penicillina e streptomicina non prolunga la durata media della sterilità intestinale e può ostacolare il ristabilimento della flora normale.

6. La durata della spedalizzazione preoperatoria risulta diminuita usando, nella preparazione agli interventi sull'intestino, neomicina per ventiquattro ore.

RÉSUMÉ

1. La néomycin seule est un adjuvant préopératoire satisfaisant pour les opérations intestinales.

2. La néomycine par elle-même ne purge pas (par exemple, elle ne liquéfie par les selles).

3. Les antibiotiques ne devraient pas être utilisés d'une façon courante dans le traitement post-opératoire des intestins après préparation préopératoire à la néomycine.

4. L'intestin devient stérile aux bactéries aérobies avec la néomycine durant 24 heures dès la fin de l'opération; cette stérilisation dure en moyenne 5 jours et demi après l'opération, mais elle peut être maintenue durant trois à 10 jours.

5. L'utilisation post-opératoire de pénicilline et de streptomycine n'augmente pas la durée de la stérilisation intestinale; elle peut empêcher le retour de la flore intestinale.

6. L'hospitalisation pré-opératoire est diminuée par la cure de 24 heures de néomycine.

SUMARIO

1. Apenas a neomicina constitue um elemento útil no preparo do intestino para operação.

2. A neomicina por si própria não prepara o intestino mecânicamente (ela não liquefaz as fezes).

3. Antibióticos não devem ser usados rotineiramente no preparo pós-operatório de pacientes submetidos a operações intestinais depois do preparo do intestino com neomicina.

4. O intestino é esterilizado das bactérias aérobias com o preparo de 24 horas pela neomicina antes da operação e, em média, cinco e meio dias no pós-operatório. Esta esterlização poderá ser mantida por três a dez dias.

5. O uso pós-operatório da penicilina e estreptomicina não aumenta a média de duração da esterilização intestinal, e pode interferir no retôrno da flora.

6. A hospitalização pré-operatória é diminuida pelo emprêgo da neomicina durante 24 horas.

ZUSAMMENFASSUNG

1. Neomycin ist ein ausreichendes Hilfsmittel zur Vorbereitung des Darmes für operative Eingriffe.

2. Die Wirkung des Neomycin führt nicht zu einer mechanischen, d.h. auf Verflüssigung des Stuhles beruhenden Vorbereitung des Darmes.

3. Kranke, die vor einer Darmoperation mit Neomycin vorbereitet worden sind, sollen nach dem Eingriff nicht routinemässig mit Antibiotika behandelt werden.

4. Nach 24-stündiger Vorbehandlung mit Neomycin ist der Darm am Tage des Eingriffs frei von aëroben Bakterien und bleibt durchschnittlich fünfeinhalb Tage nach der Operation steril; dieser Zustand kann aber drei bis zehn Tage lang bestehen bleiben.

5. Die Verabreichung von Penicillin und Streptomycin verlängert nicht die Dauer der Sterilität des Darmes, kann aber einen störenden Einfluss auf die Rückkehr der normalen Flora ausüben.

6. Durch Anwendung der 24-stündigen Darmvorbereitung mit Neomycin lässt sich die Dauer des Krankenhausaufenthaltes vor der Operation abkürzen.

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Be very wary of opinions that flatter your self-esteem. Both men and women, nine times out of ten, are firmly convinced of the superior excellence of their own sex. There is abundant evidence on both sides. If you are a man, you can point out that most poets and men of science are male; if you are a woman, you can retort that so are most criminals.

—*Russell*

Treatment of Anorectal Fistulas

STUART T. ROSS, M.D., F.A.C.S., F.I.C.S.

HEMPSTEAD, NEW YORK

THE problem of fistula-in-ano is primarily one of eradicating the fistula in a single operation without destroying the continence of the sphincter ani.

Etiology and Diagnosis.—The cause of the ordinary fistula is known to all and will not be described in detail here except to note briefly that it results from infection beginning usually in the preformed anal ducts located in the anal crypts, or sometimes in an anal ulcer. The infection thus started burrows by one or more of several routes into the surrounding tissues, forming an abscess that ruptures or is incised surgically, and a fistula is born. Textbooks to the contrary notwithstanding, tuberculous fistulas are rare, as are fistulas with high internal openings in the rectum above the anorectal muscle ring. However, it is well established that long-standing fistulas may develop into malignant tumors, and this alone is sufficient reason for eradication of the lesion. It should also be kept in mind that actinomycosis and tuberculosis, although uncommon, may be present. Fistulas with high rectal openings are almost invariably due either to trauma or to intraluminal incision of an abscess erroneously thought to be submucous.

Detection of the presence of a fistula is unlikely to tax the diagnostic acumen of the surgeon. However, determination of the actual tract and its ramifications, as well as the exact location of the internal (or primary) opening often presents difficulty.

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Methods of Finding Internal Opening.—There are several rules of thumb based on the location of the external opening which may lead the surgeon to certain suspicions. These rules may be enumerated as follows:

1. When the external opening is within 1 cm. of the anal verge the tract usually does not undermine the subcutaneous external sphincter but often does have a blind submucous extension above its internal opening at the anorectal line.

2. When the external opening is large, irregular, and has undermined edges, tuberculosis may be suspected.

3. An external opening surmounted by a sizable tuft of granulation tissue is likely to indicate a deeply situated tract.

4. The presence of a number of external openings usually, though not invariably, indicates several branches of a single tract with a single internal opening.

5. An external opening 1 or 2 cm. lateral to the tip of the coccyx may indicate a retrorectal sinus.

6. The presence of two external openings, located more or less symmetrically one on each side, often indicates a horseshoe fistula with a single internal opening in the posterior commissure even if one of the openings is located in an anterior perianal quadrant.

7. Finally, there is Goodsall's rule with which most surgeons are familiar and which states that an external opening located posterior to a line drawn transversely through the anus indicates a curved tract with the internal opening in the posterior commissure, whereas an opening anterior to this line signifies a superficial

straight tract proceeding radially into the anus.

Let me emphasize that none of these indications is to be taken as more than a clue.

Since the eradication of a fistula requires also the elimination of the source, which is to say the internal or primary opening, the exact location of the latter becomes a matter of prime importance. This is not always easy. Several methods are available. In the first place, since most primary openings are located in the anal canal at or below the anorectal line, it becomes imperative first of all to visualize that area with a suitable anoscope, good illumination and a suitable crypt hook. Many such hooks are on the market, although my personal preference is for a thin probe with its distal ¼ inch (0.6 cm.) bent at an angle of 60 degrees. The crypts are visualized and explored, as is the lining of the anal canal distal to the crypts. Many an obvious internal opening has been missed, in spite of careful search, because it was low in the anal canal.

Careful palpation of the perianal tissues will often reveal a cordlike induration representing the tract and leading the finger toward its intra-anal terminal.

The use of such dyes as methylene blue at the time of operation is in most cases unnecessary and often results in a dense staining of the entire field that obscures more than it reveals.

In dealing with deep and complicated fistulas, it is occasionally useful to inject the tract with warm Beck's paste or lipiodol and then to take stereoscopic roentgenograms of the area. In such a case it is essential to remove carefully all of the radiopaque substance from the skin to avoid a misleading picture.

At the time of operation it is often useful to visualize the suspected portion of the anal canal and anorectal line with a suitable speculum. Traction with an Allis clamp on the external opening may then produce a visible dimpling at the site of the internal opening.

Treatment.—Surgical cure of the fistula is theoretically simple and consists merely in converting the tunnel into an open gutter, removing all or as much as possible of the diseased tissue. All surgical treatment of anorectal fistula is based upon this principle. This means that *all* tissue overlying the tract must be incised, including whatever muscle may intervene between the tract and the surface of the skin. In addition, enough surrounding uninvolved tissue must be removed to provide adequate drainage, and this drainage must be maintained by painstaking postoperative care. With a simple, straight, superficial tract this is comparatively easy.

To describe, however, an operation on a deep curved posterior fistula with several external openings: Owing to the tortuous route of the tract in such a case it will probably not be possible to pass a probe directly from the external to the internal opening. Instead, the probe is inserted in one external opening and the overlying tissue incised, after which the probe is reinserted in a new direction. This process is continued until all tracts are completely laid open to and through the exact internal opening. In the process it will undoubtedly be necessary to incise considerable portions of the sphincter musculature. It should be emphasized that even if a large amount of muscle extends between the tract and the skin surface it must all be cut if the fistula is to be cured. In some cases it may be advisable to do this in two stages, incising the majority of the muscle bundle in the first stage, securing the remaining muscle with a seton as a marker, and incising the remaining muscle later, after the first incision has healed. Fortunately this is not always necessary, as the presence of even a small amount of intact puborectalis will

ordinarily insure adequate continence.

Occasionally the surgeon may be disconcerted to find, on inserting a probe in the external fistulous opening, that the instrument proceeds for 3 or 4 inches (7.6 to 10.1 cm.) in a straight cephalad direction, with no tendency to turn toward the anus. In the great majority of such cases a side branch will be found extending to an internal opening in one of the usual locations. The problem immediately arises, however, of providing proper drainage for the deep end of this sinus-like tract. This problem is solved by first removing all horizontal tracts and the internal opening in the manner previously described. An incision is then made from the depth of the vertical tract directly posteriorly toward the coccyx. If necessary, the sacrotuberous ligament and the gluteus maximus may be partially divided. After excision of surrounding skin and fat in order to "saucerize" the wound, a sizable defect is left. However, by this means adequate drainage is provided, and it is well to remember that postoperative difficulties after fistula operations result mostly from wounds which are too small rather than from those which are large.

Although fistulectomy wounds will heal more quickly and with less trouble if the entire tract wall is removed, it is sometimes advisable to leave a small portion of the deep wall where a large amount of sphincter has been divided. The portion thus left is that part which passes through the muscle, and it is permitted to remain in order to prevent, by its fibrous attachment to the muscle on each side, too great a retraction of the muscle ends. In such a case, however, it is essential thoroughly to remove all granulation tissue by means of a curet and to take especial care during the postoperative period to prevent bridging and pocketing of the site.

Pitfalls and Complications.—With the exception of incontinence, complications of fistulectomy are nearly all due to inadequate operation. In particular, the following points are stressed:

1. It is essential to find and eradicate the internal opening. There is no substitute for this, and the expert surgeon will almost always succeed in doing so. In the occasional case, however, in which the tract can be traced to a point immediately below the anorectal line but an actual opening is not found, the entire anorectal line, including all crypts for at least 1 cm. on each side of the probable site of the opening, must be excised.

2. All of the tracts should be removed; if for some reason this is not done, the remaining tract wall should be so thoroughly curetted that practically no fibrous tissue remains.

3. Wide external drainage is essential, and in this respect the surgeon must ruthlessly sacrifice any uninvolved skin and subcutaneous tissue that tends to obstruct drainage. This may leave a very large wound, but such wounds, if properly "saucerized" and cared for, will heal faster and remain cleaner than smaller ones with more nearly vertical sides. It is almost always possible to create additional drainage by carrying the incision posteriorly as far as the coccyx if necessary.

4. It is often quite easy to overlook additional external branching tracts, and this is another cause of postoperative difficulty. When the entire main tract or tracts have been laid open, a careful search should be made for additional branches. One method is to explore carefully with the probe, taking care not to err in the other extreme by creating false passages. A useful maneuver is to remove granulation tissue by curetting. A small tuft of remaining granulation tissue, apparently immune to the curet, may prove to be the entrance to another branch.

Postoperative Care.—Fistulous wounds are ordinarily not packed but if packing

has been inserted it should be removed in twenty-four to thirty-six hours and not replaced. Sitz baths and routine anal hygiene are instituted on the day following operation. If adequate external drainage has been provided, the discharge should not be unduly purulent. When a relatively clean fistulous wound begins to show a drop or two of pure pus in its depths, a meticulous search should be made for a poorly draining pocket, which must be eliminated. Premature agglutination of the deeper sides of the wound, particularly that portion entering the anal canal, may be prevented by the frequent use of a small glass rod, the size of an ordinary cocktail stirrer. This maneuver is efficacious and causes minimal discomfort to the patient. Exuberant granulations should, of course, be treated with silver nitrate and the cutaneous edges kept free from hairs by means of shaving. If it is kept in mind that the wound must heal from below according to the basic principles of surgery, and if the disease has been removed and adequate drainage provided, the postoperative care, while prolonged, need not be difficult.

Principles Regulating Division of the Sphincter. — Questions commonly arise concerning the possibility that incontinence may follow division of the sphincter. In order safely to divide the muscle, the anatomy of the sphincteric mechanism must be thoroughly learned, and it must be realized that ordinary continence depends upon the various divisions of the external sphincter ani plus the puborectalis, rather than the internal sphincter. With these facts in mind, the following principles may be propounded:

1. The subcutaneous external sphincter may ordinarily be cut in one place with impunity except in the anterior commissure in the female. In many instances even this is safe.

2. The sphincter should be cut at right angles to the long axis of its fibers.

3. In well-muscled persons, especially in the posterior commissure, it is usually possible to sever almost the entire muscle, provided that a 1 cm. bundle of puborectalis is left intact. In these cases, however, there may be some difficulty in controlling gas if a cavernous cicatrix results.

4. Muscle ends should not be packed apart for more than twenty-four to thirty-six hours.

5. If muscle ends, when severed, tend to retract unduly, they may be partially approximated with loose figure-of-eight sutures. To approximate the ends completely would, of course, defeat the purpose for which they were cut.

6. If it is necessary to sever all or almost all of the muscle, the greater portion may be divided and the remainder surrounded by a loose seton. The undivided portion may then be safely divided at a later date, when the remainder of the muscle has healed.

SUMMARY

The cause and diagnosis of fistula-in-ano are briefly discussed.

Methods of locating the internal fistulous opening are described, including use of the roentgen ray.

Surgical technic for eradication of a deep, curved, complicated fistula is described in detail, and the necessity of exact location of the internal opening, as well as for wide drainage, is emphasized. Postoperative care is described.

Six principles governing the division of the anal sphincter are enumerated.

RESUMEN

Se discute brevemente la etiología y diagnóstico de la fístula anal. Se describen los métodos para hallar las fístulas internas, incluyendo el uso de los rayos X.

Se describe en detalle la técnica quirúr-

gica para la erradicación de la fístula profunda, curva, complicada, y la necesidad de la localización exacta de le abertura interna. Se señala el amplio drenaje y el cuidado postoperatorio.

Se enumeran los seis principios que gobiernan la división del esfínter anal.

RIASSUNTO

Viene esposta brevemente l'etiologia e la diagnosi delle fistole anali, e vengono descritti i metodi per la dimostrazione degli sbocchi fistolosi interni, compresi quelli radiografici.

Viene descritta dettagliatamente la tecnica per l'asportazione chirurgica delle fistole profonde, curve, ramificate, per le quali è necessaria una localizzazione esatta dell'orificio. Viene trattata anche la terapia post-operatoria.

Se la tecnica è corretta non si hanno insuccessi nè complicazioni.

RÉSUMÉ

Bref aperçu de l'étiologie et du diagnosite.

Méthodes permettant de dépister les fistules internes, y compris par les rayons X.

Description détaillée de l'extirpation d'une fistule profonde, sinueuse, au parcours compliqué. L'auteur souligne la nécessité de connaître l'endroit exact où s'ouvre le trajet interne et l'importance d'un large drainage. Soins opératoires.

Enumération de six régions permettant de diviser le sphincter anal.

ZUSAMMENFASSUNG

Die Aetiologie und Diagnostik der Analfisteln werden kurz erörtert.

Verfahren zur Auffindung der inneren Oeffnung der Fisteln einschliesslich der Röntgenuntersuchung werden beschrieben.

Die chirurgische Technik zur Ausräumung einer tiefen gewundenen komplizierten Fistel wird in ihren Einzelheiten beschrieben, und die Notwendigkeit genauer Lokalisation der inneren Oeffnung und die Bedeutung umfangreicher Drainierung wird hervorgehoben. Die postoperative Nachbehandlung wird beschrieben.

Sechs Grundsätze werden aufgezählt, die bei der Präparierung des Schliessmuskels des Afters eine Rolle spielen.

It is awful to think that this world in which so many poets have praised has even for a time been depicted as a mantrap into which we may just have the manhood to jump. Think of all those ages through which men have had the courage to die, and then remember that we have actually fallen to talking about having courage to live.

—*Chesterton*

A Hydraulic Vein Stripper

HERBERT D. TRACE, M.D., F.I.C.S.*

CHICAGO, ILLINOIS

HOW many surgeons have sweated over timely multiple incisions when operating on varicose veins? The intraluminal stripper was designed to obviate those multiple ugly incisions. In roughly 50 per cent of the cases it has not succeeded; i.e., the stripper was blocked before it traversed the entire saphenous vein.

A change in design of the intraluminal stripper enables one to avoid most of this difficulty. Anyone who has catheterized the heart knows that the cardiac catheter passes quite easily up the veins to the heart while, simultaneously, saline solution distends the vein. Anyone who has examined a collapsed rectum by proctoscope knows that its distention with a few puffs of air will permit the proctoscope to pass up the lumen readily. Yet intraluminal strippers on the market today are forced through collapsed saphenous veins.

I have used a No. 7 cardiac catheter passed from below upward in the saphenous vein. Fifty cc. of saline solution is injected slowly as the catheter is passed. Then, because the cardiac catheter has no tensile strength, a wire is passed from above downward through the catheter. The end of the wire has a bullet which strips the vein.**

Results.—In every one of 7 consecutive patients in whom twelve greater saphenous veins were stripped, the stripper passed all the way. In no case did the stripper lodge in the region below the knee, as so frequently happens with the old type of stripper.

In 2 of these cases a febrile course ensued. The first patient had chills as soon as she left the operating room. Since the treatment of these 2 patients, however, and with scrupulous aseptic technic, there have been no more febrile responses.

SUMMARY

A simple new vein stripper is described which passes easily up the entire saphenous vein without the necessity of intervening incisions. Except in 2 early cases, in which a febrile course followed the operation, the author has obtained excellent results with this device.

ZUSAMMENFASSUNG

Es wird ein neues Instrument zur Venenextirpation beschrieben, mit dessen Hilfe sich die ganze V. saphena ohne die Notwendigkeit weiterer Einschnitte leicht herausziehen lässt. Ausser zwei Fällen im Anfang, die nach der Operation einen fieberhaften Verlauf hatten, sind die vom Verfasser erzielten Resultate ausgezeichnet.

RESUMEN

Se describe un nuevo desgarrador venoso que pasa facilmente a través de toda la safena sin necesidad de incisiones. Excepto en 2 casos, en los cuales se presentó un período febril postoperatorio, el autor ha obtenido excelentes resultados.

*Cardiac Surgeon, American Hospital, and Adjunct in Surgery, Mount Sinai Hospital, Chicago.

**This vein stripper is manufactured by Grieshaber Mfg. Co., 4501 Armitage, Chicago, Illinois.

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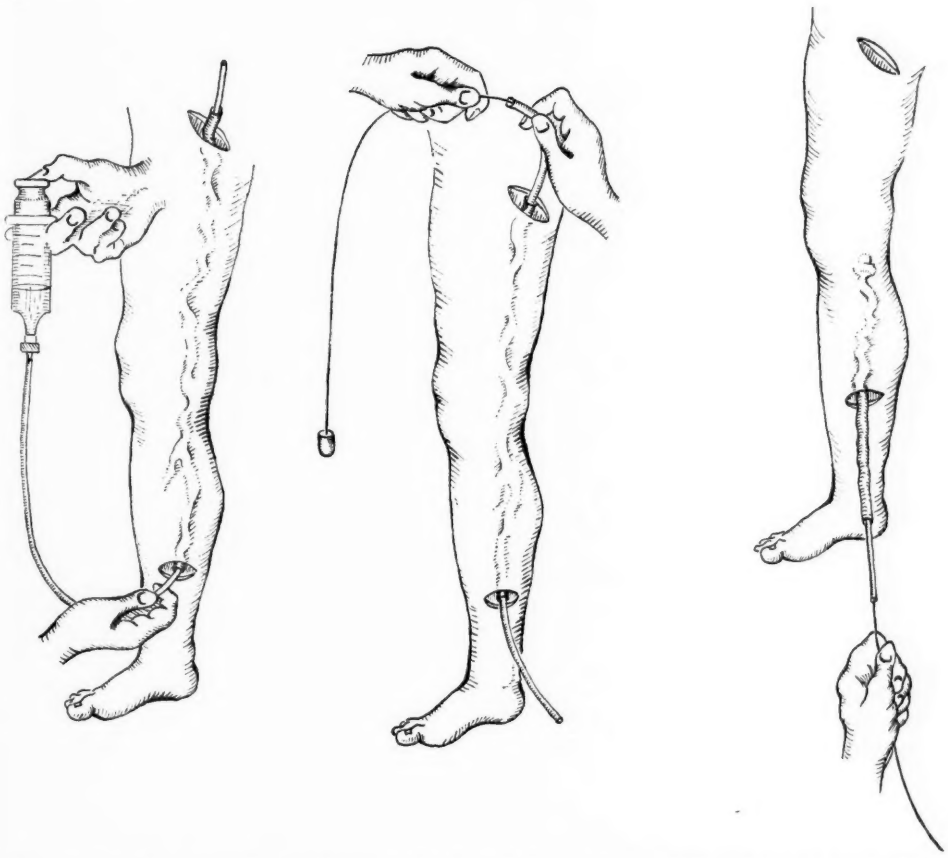

Left, insertion of catheter into saphenous vein, from below upward. *Center*, obturator passed from above downward through catheter. *Right*, obturator with bullet strips the vein.

RÉSUMÉ

L'auteur décrit un nouvel instrument très simple qui s'introduit tout le long de la veine saphène et qui permet, en la retroussant, de l'extirper sans pratiquer d'incisions. Grâce à ce procédé l'auteur a toujours obtenu de bons résultats, sauf dans deux cas où l'opération fut suivie d'un état fébrile.

RIASSUNTO

Viene descritto un semplice strumento per strappare le vene, che viene introdotto lungo tutta la safena, senza incisioni.

Tranne in due casi, in cui vi fu febbre dopo l'intervento, l'autore ha sempre avuto degli eccellenti risultati.

Section on Ophthalmology and Otorhinolaryngology

PAUL C. CRAIG, M.D., F.A.C.S., F.I.C.S., EDITOR

Indications for Eye Surgery

Physiologic Bases

ARTHUR ALEXANDER KNAPP, M.D., F.A.C.S., F.I.C.S.

NEW YORK CITY, NEW YORK

EVER since diseases of the eye were first recognized, the indications for surgical treatment have been paramount problems. At present they are still paramount problems, but they may be resolved when the indications are based on physiologic concepts, since this will provide an approach to uniform criteria. Uniform criteria, understood by all, will not only strengthen the ophthalmologists' prestige but more importantly, will help in the world-wide endeavor to prevent blindness. In their quest for the indicated therapy for ocular maladies, patients and even physicians are often confused by the varying and sometimes diametrically opposed advice of the several specialists. With criteria more nearly uniform, they will be given more consistent advice.

The following observations are based on my own judgment as to surgical intervention, a judgment founded on experience. Some of my readers may have had experiences that would alter the conclusions set forth in this report, but it is only by pooling of their experience that surgeons can finally arrive at the best basic criteria for surgical decisions.

Although the question of the time to operate is a moot point, the sole physiologic criterion is threatened or an actual loss of vision. Fundamentally operation should be performed only when the condition is potentially surgical and medical treatment has failed to control or improve it, or when medical therapy presents a greater hazard to vision than does the proposed operation. Each patient must be individually studied.

Age is of no definite concern in the decision to operate; ocular operations can be performed at any time from the first week of life to the last. Nor is hypertensive vascular disease a bar to surgical intervention. Though the internist may prefer to have the hypertension reduced preoperatively, his treatment should not necessarily delay an operation; even abnormally high blood pressure is of secondary significance. Dr. John Wheeler came to that conclusion years ago and my similar experience leads me to concur.

The same rule may be followed with other systemic diseases. Syphilis is present in a comparatively high percentage of inmates at Sing Sing Prison Hospital. During and after my operations on the eye, I have never observed any complication attributable to syphilis.

These same observations have been

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made on tuberculous patients. With regard to diabetes, the state of hyperglycemia need not determine the time to operate. Some excessive bleeding may be anticipated, but this complication can be well controlled; if the hemorrhage is intraocular it usually clears spontaneously without complication. Despite the fact that the new antibiotics have radically reduced the incidence of serious ocular infection, it is inadvisable to operate in the presence of local disease, except for the specific purpose of curing the focus of infection.

Concerning smears and the punctilious preparation of the patient for operation there are two schools of thought. A simple preoperative preparation is favored. A mild silver protein is prescribed for two days prior to surgical intervention. Parenteral procaine penicillin is routine. No conjunctival smears are taken; thus no pathogenic organisms are encountered which contraindicate the procedure. Clinical appraisal is sufficient. Except in cases of cataract extraction, no preoperative enema is ordered. When the patient is on the table, alcohol only is applied to sterilize the skin and cilia, while the conjunctiva is irrigated with boric or saline solution.

Let us now examine the several conditions for the specific pathologic criteria which will indicate surgical intervention.

Cataract.—The definition of cataract, opacity of the lens, is in need of clarification. Scientifically, it has been my experience that the corneal microscope reveals a cataract in every person, child and man alike; no lens checked was ever completely clear. In the normal eye the "cataract" does not impair sight. In the clinically cataractous eye, however, there is interference with vision.

Since surgical therapy offers the only means of improving this vision, the time to operate is of primary concern to the patient, his physician and the ophthalmic surgeon. There are still differences of opinion as to the time, for the most appropriate time depends on the particular patient. Basically, however, the time to operate is when the vision of the patient is embarrassed, when he no longer can carry on his daily routine because of the cataract. A person in need of high visual acuity will be ready for operation with a vision of 20/40 (comparatively good eyesight for the majority of persons), whereas a housewife or a day laborer may be more than content and efficient at work with 20/200 or 20/100 vision—practically the equivalent of industrial blindness.

Apart from the actual loss of sight, there are occasions when it may be necessary to operate to offset the emotional disturbance attendant upon the patient's knowledge that he has a cataract. Although it is often said that it is essential to wait for the maturity of a lens opacity, many opacities, especially those of the nuclear type, never ripen. A case in point is that of an active, energetic, successful business man 71 years of age with bilateral cataracts. For twenty years he had been suffering from a marked loss of vision due to lens changes. He had been repeatedly advised to wait until the opacities ripened. Examination revealed nuclear sclerosis, a type of cataract that usually never ripens. Operation was decided upon because of the visual loss. After the date had been set for the cataract extractions, cardiac failure developed and the patient died before the operations. Early removal of the lenses would have given this man twenty years of normal sight instead of the twilight of partial blindness. This case well illustrates the fallacy of waiting for the maturation of cataracts.

Occasionally one encounters low grade iritis associated with an advanced, complicated cataract. If strict elimination of foci of infection—and really strict—does not cure the iritis, it is suggested that lens extraction be considered in order to clear the inflammation which may be an

iritis phaco-anaphylactica. Postoperative healing is not interfered with by the presence of iritis.

A cataract complicated by glaucoma is always a problem. Although some ophthalmologists advise initial operation for glaucoma at all times, I do not share their opinion. When a cataract is complicated by glaucoma, both the cataract and the complicating hypertension may be cured by removal of the lens. If it is not, mild medical antiglaucomatous therapy is sufficient to keep the tension normal and the physiologic test results within bounds. Should the glaucoma persist uncontrolled, however, further operations can be performed at this later date.

Glaucoma.—In the New York area glaucoma is not the serious blinding disease of former years; blindness due to this cause now is infrequently observed. Improved nutrition may be one of the basic reasons, but improved care of the eye, earlier detection of the condition and operation soon after its onset are major contributing factors. Early operation should be emphasized. Early operation, when damage to the eye first becomes apparent, gives the patient the best chance for good recovery, with very good vision throughout his life. Chief consideration must be given to the primary type of glaucoma. The following observations are directed to this most frequent type—primary chronic simple glaucoma.

Once the diagnosis of glaucoma is established, it is well to prepare the patient psychologically for operation. In only a very small percentage of cases is operation unnecessary; in these exceptional cases the glaucomas either never progress or are controlled by medication. There may even be a rare cure; the results of physiologic tests and the tension become normal; subjective complaints disappear. In the large majority of cases, though, the condition does progress, and the patient, if operated on early, can have good vision throughout the years ahead. Early operation is far more dependable than the expectation that the patient will carry on a continuous course of necessary treatment. Early operation is visual insurance, and one should err, if at all, on the side of decisive action.

Glaucoma, when first observed in the advanced stage, with tubular vision, must be expected to progress still more and will cause blindness unless the hypertension is checked. Without question, despite the greater hazard, operation is to be advised. I have performed successful operations on such eyes, after which the patients retained their sight for years.

Abnormally high tension within the globe itself indicates the diagnosis of glaucoma. This increased tension usually is determined by the tonometer, which is taken as the standard means of measurement; the value of finger palpation is considered questionable. That, however, is not the case. In my hands, palpation of the globe has proved to be an important phase of every eye examination, glaucoma being discovered in the adult as well as in the child, quite often in cases in which the tonometer, checked for accuracy, gave a normal reading, and when no other suggestive sign was present. It may be mentioned that finger palpation for initial intra-ocular tension is more accurate qualitatively and that the result generally is higher than that obtained by the tonometer after the instillation of drops. The mere instillation of drops, with consequent closure of the lids, apparently acts in similar fashion to massage of the globe, with a resultant reduction in ocular tension. In the absence of raised pressure, the surgeon should not be deterred from operating when other tests prove the condition to be present. There are many glaucomatous eyes that never, on examination

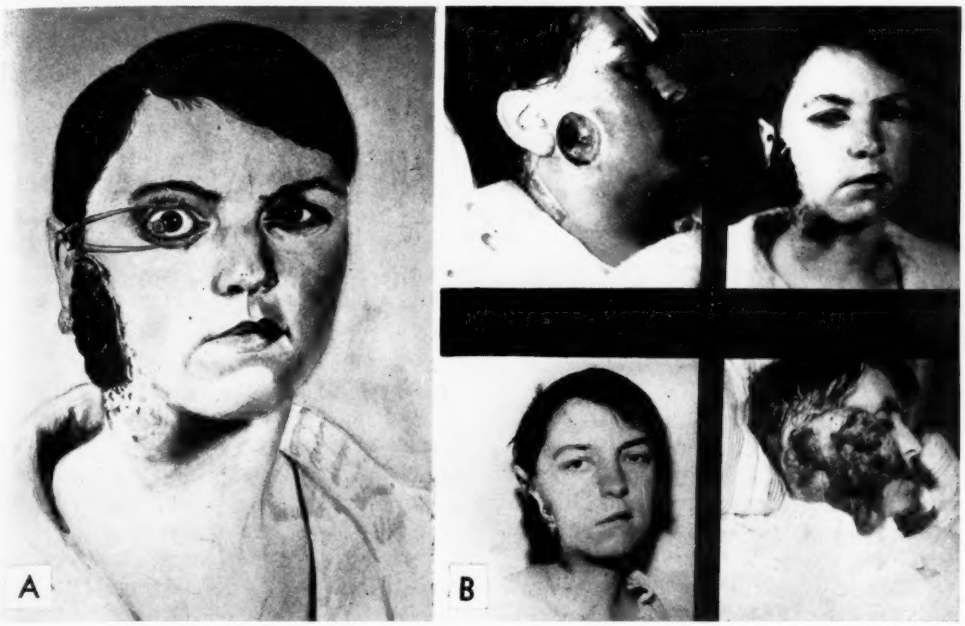

Fig. 1.—*A*, patient with parotid tumor and dermoid cyst in eye undergoing melanotic degeneration. *B*, parotid area after excision of melanoma and rapid subsequent growth of tumor. Last photograph taken two days before death. Autopsy revealed melanois cells in both ocular dermoid and parotid tumor.

by the oculist, reveal hypertension. Increased intraocular pressure in a given eye is that pressure which is too great for that particular globe and which therefore gives rise to loss of peripheral and/or central vision. Since such tension is relative and dependent upon the particular eye, it is an indeterminate normal prior to its establishment. Therefore, in the use of the tonometer, it is well to be guided by both these facts—apart from the inherent errors in the tonometer itself—that the tonometric reading is actually less than the true measure of the pressure exerted by the intra-ocular fluids upon the fibrous tunic and that abnormal pressure within the eye really depends upon the individual eye. Both of these facts point to the conclusion that many cases of glaucoma fall within the normal range of the tonometer; hence, other physiologic tests must reveal the diagnosis if the disease exists. Two very early signs of glaucoma may be emphasized, signs that have proved valuable: deepening or enlargement of the physiologic cup, with the vessels pushed to one side, and the Roenne step.

It is true that failing vision in a glaucomatous eye calls for surgical intervention, but only when the failing vision is caused by the hypertension. Retrobulbar neuritis can and does complicate a glaucomatous condition. It is a diagnosis to be borne in mind, a diagnosis which may make it unnecessary to operate. Likewise, the presence of chorioretinitis as the cause of the failing vision will obviate the need of intervention. Incidentally, a rehabilitating process, with particular attention to the strict elimination of foci of infection, especially the silent sinus, often will cure the neuritis promptly and arrest or cure the chorioretinitis in comparatively

short order.

After surgical intervention the glaucoma may continue to advance despite medical treatment; then a second or even a third operation is in order. Glaucomatous damage must be controlled if at all possible. One procedure usually suffices, but further operations may be undertaken safely without regard to the time lapse, except that an eye free from inflammation is preferred postoperatively.

Strabismus.—For the purpose of this discussion, strabismus will include both manifest and latent deviations of the eye.

Before resorting to surgical intervention, one should try all other possible means of correction. It is surprising sometimes to find the strabismus, the divergent or even the convergent, respond to medical therapy. Operation is to be advised only when the nonoperative measures have been evaluated and found wanting. The decision to operate must imply a reasonable chance for improvement of the symptoms. It is agreed that the best time to straighten eyes is before the age of 6; after that, it becomes increasingly difficult to keep the eyes straight and to maintain binocular single vision. The time to operate, however, will be determined by the surgeon's experience. In the case of strabismus, accommodative or paralytic, in which operation seems to offer the only means of cure, the age of the patient is not to be considered.

The improvement of vision in the manifestly "crossed" eye and the development of binocular single vision usually are of less importance than the primary aim of this operation—cure of the sense of inferiority accompanying the condition. On many occasions such an emotional complex may be very deeply rooted, as was a patient of mine, a young lady who, excepting for her tropia, is a very pretty girl. Since her eyes have been straightened her personality is completely changed. From an introvert she has become an extrovert. No more appreciative patient can be seen, particularly if she receives a proposal of marriage.

The inferiority complex, however, is not confined to the female. An outstanding surgeon in his early seventies recently came to the office for correction of a marked convergent strabismus of 42 degrees, present since childhood. After the operation he, too, was highly pleased, perhaps because he is married to a beautiful woman much younger than himself.

Retinal Separation (Detachment).—Separation of the retina is more frequently spontaneous than tramatic. There are occasions when the separation is due to a neoplasm, the result of ocular degeneration, or to some other complicating basic disease. The treatment in these instances will depend upon consideration of the problem as a whole. In cases without complications, cases in which there are no contraindicating factors and in which the retina may be replaced, operation offers the most generally accepted method of cure at present. But since there are instances of retinal detachment cured by palliative means, most patients may be immediately confined to bed, given medical treatment and observed for a number of days, without fear of complicating the operation if it becomes necessary.

It is of particular interest to speak of the recent medical cure of 4 out of 7 cases of spontaneous partial retinal separation, present from a few days to six months. Three of the cured conditions were bullous separations and one was flat. They were all given complete bed rest and salt-free diets plus mercuhydrin and ammonium chloride. The rice diet may be substituted for the salt-free. After this procedure, should reattachment not be a continuous process, then operation is to be performed, with the knowledge that, practically, there has been no interfer-

ence with the final outcome of the procedure.

Since it is recognized that this very small number of eyes medically cured of detached retinas is really no index of the potential value of this treatment, it is suggested that this type of therapy be administered to many more patients in order to evaluate it properly.

In the event that the first operation is unsuccessful or that there is a recurrence of the condition, a second or even a third may be carried out. The time between operations will be gauged by the quiescent state of the eye and occasionally by the type of operation previously performed.

Enucleation.—Enucleation, as a rule, is to be advised in all cases of blind, painful eyes. Some of these globes will reveal intraocular growths. There are occasions, however, when an intraocular neoplasm is observed preoperatively; then enucleation or exenteration is to be recommended, enucleation for the intraocular growth and exenteration for the growth not confined to the globe. In a patient with bilateral retinoblastoma, one should attempt to preserve one eye.

Malignant growths on the lids, on the surface of the globe or localized within the iris may often be excised widely and the eyeball saved. Recently I have excised a pigmented tumor of the ciliary body and preserved the eye. Pathologic section of the growth revealed a benign melanoma.

To emphasize the fact that growth of the tumor is not necessary for the diagnosis of malignant disease or for the development of metastases, two slides may ve viewed. Figure 1*A* is a drawing of a twenty-six year old girl who complained of a recently observed parotid tumor. Because of a growth in the eye, a consultation was advised. The growth proved to be a dermoid cyst, within the center of which was a small brown area. I made a diagnosis of dermoid cyst undergoing melanotic degeneration. Figure 1*B* shows the parotid area after excision of the melanoma and the rapid subsequent growth, the last photograph having been taken two days before death. Autopsy revealed similar melanotic cells in both the ocular dermoid and the parotid tumor.

Since one can never positively differentiate the benign nevus from the malignant melanoma by clinical means, it is my general policy to excise external ocular pigmented nevi, especially if they are cosmetic blemishes.

When the possibility arises of seriously endangering a sound eye by sympathetic ophthalmia, enucleation should be considered. Removal of an eyeball, though, is never urgent. Any eye may change radically in a week after a severe injury, and signs of sympathetic irritation in the fellow eye are not to be construed as the onset of sympathetic ophthalmia. Sympathetic irritation is seen frequently; sympathetic ophthalmia is not.

It is also unnecessary to enucleate an eye directly after a perforation in the ciliary body region. I have several times seen cases in which this type of accident was complicated by prolapse of the ciliary body. On one occasion there was a second herniation of the ciliary body in the adjacent area of the same eye. The herniated tissue was always excised and the wound closed, and an uneventful recovery, with normal or good useful vision, was obtained in each case. No evidence of sympathetic ophthalmia has been observed up to the time of writing, twelve years having elapsed for the first 3 patients.

Injuries to the Eye.—Injuries to the orbit are self-indicative of the type of operation required. Since the orbits are so conspicuous, it is not surprising that the fine differences between them are noticeable. Therefore, careful repair of a wound is imperative. "Always overcorrect" is an excellent rule.

Although secondary suture may be of benefit in other parts of the body, primary closure of wounds of the orbit is in order. Repair of the tissues as soon as possible after the injury is suggested, since the traumatic reaction will present added difficulties. As a rule, foreign bodies in the orbit, but outside the globe, are not a cause for concern.

For accurate localization of a foreign body within the globe, roentgen films should be taken; also, when there is a question of an intra-ocular foreign body, roentgenograms are needed. Figure 2 shows the right orbit of a youngster who was shot in the eye with a BB gun. The shot is visible within the globe. On first examination, no wound of entrance could be found either in the lids, which were markedly swollen and discolored, or in the severely tramatized eye; nevertheless, roentgenograms were ordered and the child given palliative therapy. Later, the roentgen report revealed an intra-ocular circular metallic foreign body. On the boy's next visit to the office, a few days later, a more minute search was carried out for the perforation. Moderate traction was made on the still swollen lids; in this process, unavoidable pressure was exerted around the fornices so that as much of the globe as possible could be exposed for inspection. As the inferior central fornix was exposed, the BB shot popped out of the eye. Surrounding the shot as it emerged from within the eye was a yellowish mucoid material which continued posteriorly to form a tail for the shot. The eye had been saved.[1]

Fig. 2.—Right orbit of child shot with BB gun (see text).

From this experience, may I suggest that in the presence of an intra-ocular foreign body not attracted to a magnet a similar procedure be resorted to? Place the patient in bed, his position varying with the location of the perforation to favor gravity; wait a couple of days, and then carefully express the globe, before attempting the dangerous intra-ocular instrumentation for removal. Success with this simple maneuver should save the eye.

Myopia.—Surgical treatment for high myopia has been advocated for years. Myopia, however, is only one symptom of a systemic disease—mesenchymal hypoplasia. In my published and unpublished reports concerning every type of myopia, including malignant myopia up to minus 41 diopters, I have never advised operation. On the contrary, I have prescribed sufficient calcium and sufficient vitamin D. Reduced myopia and improved vision in these "advanced cases" frequently takes place, regardless of age. Ample improvement should make it unnecessary to operate.

Plastic Surgical Procedures. — Prevention of plastic operations, of course, is the ideal. Congenital anomalies and developmental blemishes are unavoidable, but there is a large class of plastic operations that lends itself to prevention. Proper, immediate care of the injured orbit will prevent the need of much future plastic intervention.

Whenever a cosmetic blemish appears in the eyeball or lids, that is the time to operate, provided that the operation weighs in the patient's favor. Scar tissue is the cause of most cosmetic defects. Except for burns of the orbit, for which there may be a direct indication for a plastic procedure, it is generally well to delay operation for a recent defect resulting from trauma until the optimal state of healing has taken place. Whenever there is a choice of a graft for the correction of the disfigurement, I favor the free skin graft rather than the sliding type. Nontraumatic blemishes of the lids or globe may be corrected at the patient's request or at the surgeon's suggestion.

Dacryocystitis. — Acute dacryocystitis may be an indication for surgical treatment, but a chronic infection of the tear sac was formerly the indication. My most recent patients with the latter type of infection have been cured by penicillin drops and/or instillation of the drug into the lacrimal sac. After a trial of this therapy, without cure, operation can be performed.

Corneal Opacity. — Reduced vision and/or scarring may be the indication for surgical intervention for a corneal opacity. Prior to any corneal operation it is necessary for the opacity to have reached its optimally healed state; all vascularization of the membrane must be absent to insure success. In the presence of a partial corneal opacity, not involving the whole corneal area but entirely covering the pupil and thus reducing vision, the indicated surgical procedure is corneal tattooing followed by an optical iridectomy. The two procedures may be done simultaneously. Regularly I advise this procedure rather than use of the much less successful corneal graft. Tattooing and iridectomy will in no way jeopardize the results of a later transplant, should such an operation ever be deemed advisable.

Fig. 3.—Patient treated by tattooing with iridectomy fourteen years prior to time of writing; 20/20 vision resulted, and the tattooing remained effective.

If the opacity only partially occludes the pupillary area, the remaining transparent cornea anterior to the pupil will still permit good vision. Iridectomy is unnecessary in such an eye. Tattooing, however, will serve the dual purpose of enhancing the appearance and improving the vision. The pupil after the corneal tattooing permits this improved vision because it gets the effect of a pinpoint diaphragm, which pinpoint opening in an opaque material, placed before the eye, practically always improves vision.

If the scarring of the cornea is a cosmetic blemish outside the pupillary zone, tattooing will cure the blemish. According to the background of the defect, the cornea may be colored black, blue or brown.

Two or even three tints, if indicated, may be applied at the same sitting.

Tattooing with iridectomy is safe, simple, permanent and devoid of late complications. Tattooing has been effective for over eighteen years. Figure 3 shows a young lady who had a tattooing with iridectomy performed in her right eye fourteen years ago; 20/20 vision resulted, and the tattooing remains effective.

This case also illustrates the fact that 20/20 vision is to be expected with any eccentrically placed pupil so long as all other structures in the globe are normal and the cornea anterior to the proposed pupillary opening is clear. The iridectomy resulting in the new pupil may be nasal, temporal, superior or inferior to the normal pupil. Normal vision may be anticipated.

CONCLUSION

The actual time for operation in the presence of the several conditions discussed is a matter that must be determined by the surgeon on the basis of the individual case, always with due consideration of the expected result of medical treatment. Underlying the decision, however, there is but one simple rule: The time for ophthalmic surgical intervention is the time when vision is threatened or actually lost.

SCHLUSSFOLGERUNGEN

Der angemessene Zeitpunkt zum operativen Eingriff bei verschiedenen in der vorliegenden Arbeit erörterten Augenerkrankungen muss vom Chirurgen je nach der Lage des Einzelfalles und immer unter Berücksichtigung der Möglichkeiten medizinischer Behandlung bestimmt werden. Es gibt aber nur ein Gesetz, de dieser Entscheidung zugrunde liegt, und das ist: der Zeitpunkt für einen chirurgischen Eingriff im Auge ist gekommen wenn die Sehfähigkeit bedroht oder verloren ist.

CONCLUSIONES

El tiempo de operación en presencia d los diversos padecimientos es un asunt que debe determinarse por el cirujan sobre la base del caso individual consid erando siempre el resultado esperado de tratamiento médico. Sin embargo la deci sión está en una regla sencilla: El tiemp de la operación oftálmica es el tiempo en que la visión se amenaza ó se pierde.

CONCLUSIONI

La scelta del momento adatto per l'intervento deve essere fatta dal chirurgo caso per caso, vagliando debitamente i risultati della terapia medica.

Vi è, tuttavia, una regola semplice: si deve intervenire quando la vista è indebolita o quasi perduta.

RÉSUMÉ

Le chirurgien, après un traitement conservateur précis, déterminera le moment opportun d'une opération suivant chaque cas particulier. Ce moment opportun pour une intervention chirurgicale ophtalmique sera appliqué au moment où la vision est menacée ou lorsqu'elle est déjà perdue.

REFERENCE

1. Knapp, A. A.: Simple Removal of Intra-Ocular Foreign Bodies, J.A.M.A., 148:119 (Jan. 12) 1952.

(This statement has just been corroborated at a recent world-wide meeting of ophthalmologists held in Montreal, Canada, in August, 1954. The upper normal limit of the tonometer reading has been found too high, and therefore it has been reduced.)

Editorial

A New International Service

THE International College of Surgeons, which from the day of its founding has been constantly alert to the needs of surgeons the world over, remains mindful of both its debt to the past and its responsibility to the future. As is now well and widely known, the College is making a signal acknowledgment of the former by establishing the International Surgeons' Hall of Fame. We are now prepared to announce the filling of another long-felt need: the need for an INTERNATIONAL SURGICAL FILM LIBRARY.

The advantages of such a service are obvious. On all levels of education, nowadays, the use of audiovisual aids is steadily increasing. The foresight of the American Medical Association has made such facilities available to surgeons here at home. We consider it our natural responsibility, as an organization devoted to science—without geographic boundaries — to set about making them available to our members abroad.

At its most recent meeting the Board of Trustees of the College, putting into initiatory action this long-planned addition to the College program, requested that Dr. Philip Thorek be asked to assume the duties of Director of the Surgical Film Library. Dr. Thorek's work on the Film Forums presented each year at the Annual Congress of the United States and Canadian Sections, is well known and has been much appreciated—not only in the United States, since each year's Congress brings many participants and guests from abroad. In the united opinion of the Board of Trustees, he was unquestionably the first choice for this interesting but onerous position.

After due consideration, he accepted the post without remuneration.

As the project grows and facilities are set up, the widest possible distribution of the best professional films will be available to our members. As someone has wisely said, "One picture is worth ten thousand words" when it comes to clear and instant communication. It will be the endeavor of the International Surgical Film Library to make these films easily accessible wherever the need is felt.

Another aspect of this new department of work is of paramount importance; it cannot fail to help in the cementing of international friendships, since it represents a form of genuine intercommunication with our colleagues abroad—a prolongation throughout the year, so to speak, of the warm, delightful and rewarding international contacts now largely confined to the few days of each year in our busy lives and theirs when a Congress here or elsewhere affords us the opportunity to come together. Anything that increases communication between the College and its member Sections, anything that keeps each member constantly aware of his fellow members and the collaborative nature of our work, wherever we live and perform it, is matter for rejoicing. Since one of the prime objects of the International College of Surgeons is to abolish barriers

and create good will among men of science, we take the utmost pleasure in the opening of still another new channel of cultural exchange. The growth of the College has been so rapid that the scope of its activities must inevitably widen more and more as time goes on. It is evidence of the soundness and vitality of College ideals that they are being quietly but steadily realized, one by one. Probably we shall not realize them all; life is too short; but those who come after us will find the foundations well laid.

M. T.

Superstitions are not always dark and cruel; often they add to the gaiety of life . . . received once a communication from the god Osiris, giving me his telephone number; he lived, at that time, in a suburb of Boston. Although I did not enroll myself among his worshipers, his letter gave me pleasure . . . like also the men who study the Great Pyramid, with a view to deciphering its mystical lore. Many great books have been written on this subject, some of which have been presented to me by their authors. It is a singular fact that the Great Pyramid always predicts the history of the world accurately up to the date of publication of the book in question, but after that date it becomes less reliable. Generally the author expects, very soon, wars in Egypt, followed by Armageddon and the coming of Antichrist, but by this time so many people have been recognized as Antichrist that the reader is reluctantly driven to skepticism.

I admire especially a certain prophetess who lived beside a like in northern New York State about the year 1820. She announced to her numerous followers that she possessed the power of walking on water, and that she proposed to do so at 11 o'clock on a certain morning. At the stated time, the faithful assembled in their thousands beside the lake. She spoke to them saying: "Are you all entirely persuaded that I can walk on water?" With one voice they replied: "We are." "In that case," she announced, "there is no need for me to do so." And they all went home much edified.

—*Russell*

New Books

The Thyroid. By T. Levitt, M.A., F.R.C.S., F.R.C.S.E. Edinburgh and London: E. & S. Livingstone, Ltd., 1954. Pp. 606.

Mr. Levitt has written an outstanding book on the thyroid gland.

To produce such a work was a most courageous undertaking. One needs only to read the first few pages to understand thoroughly that the author is not a conformist. This stimulating tome is the result of twenty-five years of personal study. He discusses his own theories and provides a basis for an understanding of them.

He is of the opinion that the effect of the physiologic stress and strain to which this gland is subjected is mirrored by definite histologic as well as clinical phenomena. This corresponds to similar changes in other endocrine organs, occurring in a specific pattern that continues from birth to death.

Many have accepted the workable classification recommended for descriptive purposes by the American Goiter Association: toxic and nontoxic, diffuse and nodular goiter. Mr. Levitt goes beyond this and presents a physiologic treatise, in which he describes six progressive stages:

1. Epithelial hyperplasia
2. Lympho-epithelial hyperplasia
3. Focal lymphoid hyperplasia
4. Diffuse lymphoid hyperplasia
5. Fibrolymphoid hyperplasia
6. Fibrosis.

In his opinion, since epithelial tissue is the most common constituent of the normal gland, it provides an accurate index of the pathologic state of this structure. To this he adds the role of fibrosis, which occurs as a terminal event in the history of the gland. Between these two extremes is discussed the relation of lymphoid tissue to the subject in hand. This portion of the work is highly interesting and thought-provoking.

Mr. Levitt discusses the theoretic and philosophic phases of thyroid disease as well as the more recent aspects of modern therapy with radio-active substances. The way in which the material is presented indicates that the author must be an excellent teacher.

The illustrations and text depicting thyroidectomy call for special commendation.

This all-inclusive work has over 500 photographs and plates, 60 of them beautifully reproduced in color. Also of interest is the presentation in English of the contributions of Hashimoto and Riedel.

This book can be recommended highly to anyone interested in diseases of the thyroid gland.

PHILIP THOREK, M.D.

Resistance et Soumission en Physio-biologie: L'hibernation Artificielle. By H. Laborit. Paris: Masson et Cie., 1954. Pp. 120. Charts.

To those familiar with the French spirit of logic in things scientific, the present offering will come not as a surprise but as an expected and refreshing addition to the life of learning. Nor is it surprising that Dr. Laborit, surgeon and medical investigator, should so expertly vault the bars of his profession to instruct the public at large. This he has achieved with address and brilliance, in keeping with still another Gallic tradition.

Both popular and technical presses in all the leading languages have borne witness to the achievements and challenges of artificial hibernation in surgery. Though the method is in its infancy, Laborit observes that certain reports have already yielded results of statistical significance. Thus, the subject seems "made" for this new series on the evolution of science.

It seems that the series is also "made" for Dr. Laborit. Rapidly and colorfully he sketches the biologic concepts underlying latter-day discoveries — concepts of metabolism, defense and submission, *milieu interieur,* homeostasis, aging, disease and death. Modifying Claude Bernard's "constancy of the internal humoral environment," he asserts that the important controlling factor is the maintenance of constancy in the intensity of the vital processes. On this basis, he explains, the therapeutic need is a method of the slowing down and diminishing of these processes. The first step is pharmacologic inhibition of the system of intercellular and interorganic regulation — the stage termed "neuroplegia." This is followed by artificial reduction of the body heat (hypothermy) with concomitant metabolic depression. Under these conditions the organism can under-

go more or less drastic procedures without the usual disordered and disorganizing response to surgical affront.

Here also is outlined some of the experimental work on which this procedure was based, as well as views on psychosomatic symptoms and the relation of man to society.

This book will be relished by those for whom medicine and surgery are still aspects of the great problems of general biology. A fuller technical discussion of artificial hibernation can be found in the author's *Pratique de Hibernotherapie* (1954) issued by the same publisher.

MAX THOREK, M.D.

Peptic Ulcer. By C. F. W. Illingworth. Edinburgh and London: E. & S. Livingstone, Ltd., 1953. Pp. 287. Illustrated.

The literature on peptic ulcer, already immense, is constantly increasing, both on the surgical and on the medical side. The current form of therapy is not the final one, even though cures are achieved in some cases. The surgical remedy, in particular, owes its importance to lack of a proper specific. It is clear from this situation that constant review of the disease and its treatment is needed. Many such reviews, written by men of authority, are available.

The present monograph, by the Regius Professor of Surgery at Glasgow, is one of the clearest and most distinguished in the field. Its importance is due to its rounded and complete presentation, the many years of clinical research represented, its extensive review of the literature and some heretofore unpublished data from the author's clinic.

Dr. Illingworth states at the outset that he writes not merely as a surgeon but as a student of disease. Consequently the surgical approach is but one facet of a many-sided problem. The book will therefore prove valuable to surgeon, physician, teacher and student alike. Its contents include the physiologic and pathologic pictures, the results of experimental research, the etiologic factors, the clinical picture, treatment from the psychosomatic, medical and surgical points of view, and complications. The study is completed with chapters on the ulcer-cancer problem, peptic ulcer of the esophagus, and peptic ulcer of Meckel's diverticulum.

In the chapter on surgical treatment, the comments on preoperative and postoperative care are drawn from the author's own experience. The operations discussed are gastrojejunostomy, vagotomy and partial gastrectomy. The author's own technic of partial gastrectomy is described in detail, with illustrations. In the Glasgow clinic, it is stated, "three different methods, anterior Polya, posterior Polya, and posterior Hofmeister are in regular use by different members of the staff, with results which are quite indistinguishable." Concerning the amount resected, the author, while recognizing the advantages of subtotal gastrectomy, writes as follows: "Certainly the experience of many surgeons in every part of the world shows that resection which, while extensive, falls far short of being subtotal carries only a small risk of secondary ulcer, and this risk is more than balanced by the advantages of a more capacious gastric remnant." Several technical difficulties are then discussed. Finally, there is a synopsis of some Glasgow data on the end results of gastrectomy: in over 400 cases, the operation was successful in 70 per cent, satisfactory in 20 per cent and a failure in 10 per cent.

An additional item of more than usual interest is the analysis of data on acute perforation, based on recent studies in Glasgow and Sweden.

Illustrations are adequate, with some histologic and pathologic plates in color. Selected bibliographies are included.

MAX THOREK, M.D.

Men have to find truth; not because it is lost, but because they are lost.

—*Panin*

Abstracts from Current Literature

Gastro-Esophageal Reflux in the Adult (A propos du reflux gastro-esophagien de l'adulte). Hilleman, P., Wattebled, R., and Bennett: Presse Méd. 62:111, 1954.

When looked for, the passage of gastric contents into the esophagus without the participation of the gastric musculature is not as uncommon as it is thought to be. Bombart encountered up to 121 cases of reflux in 258 patients with various forms of dyspepsia.

Clinically, the condition may be latent and encountered only in the course of examination, or it may be revealed by dyspepsia, pyrosis, nausea and vague digestive complaints. When it is suspected, a barium meal is of greatest diagnostic value and the interpretation is quite easy: the roentgenogram shows retrograde filling of the esophagus by the contrast medium. After the stomach has been filled and the esophagus evacuated, an ascending refilling of the latter is diagnostic.

Esophagoscopic study may often help by revealing esophagitis, but this is not constant. The authors also point out that the extent of esophageal lesions is not in direct relation to the subjective symptoms.

Reflux may have a functional or a secondary cause. It may be secondary to a distal esophageal lesion, to a hiatus hernia, to an abnormality of the cardia, to sequelae of operation in that region or to brachiesophagus. Functional reflux may be due to cholecystic disease, to pregnancy or to no detectable cause at all. These come under the heading of esophageal dyskinesia.

The consequences of a long-standing reflux are variable degrees of esophagitis, even up to hemoptysis not unlike the massive hemorrhages associated with gastro-esophageal anastomotic ulcers.

The physiologic basis of reflux is sought but seems to vary with each case. If the mechanical theory, based on the valvular action of the cardia, finds support from the results of operations on the cardia, the sphincteric theory alone can explain the clinical aspects of functional reflux. Endocrine abnormalities, especially hypothyroidism, may also play an important role.

The problem remains complex, and treatment is bound to be variable.

S. A. GUEUKDJIAN, M.D.

Fat Embolism: A Clinical and Experimental Study of Mechanisms Involved. Swank, R. L., and Dugger, G. S.: Surg., Gynec. & Obst. 98:641, 1954.

In this paper the authors emphasize the early onset of cerebral fat embolism without pulmonary signs and symptoms, describing 2 cases of cerebral fat embolism in which these features were observed.

The early onset of cerebral fat embolism is due probably either to shock and unconsciousness or to anesthesia, both presumably relaxing the vascular bed and allowing the circulation of fat, which, plus the fat from the fractured bones, is washed through the pulmonary circulation to the brain.

It is suggested that dark field examination of whole blood to determine the number and size of the circulating fat globules in the blood would be useful in the early diagnosis of fat embolism.

EDMUND LISSACK, M.D.

The Sphincter of the Pancreatic Duct: Its Role in the Pathology of the Pancreas (Le sphincter du Canal de Wirsung. Joue-t-il un rôle dans la pathologie du pancreas?). Leger, L., and Lataste, J.: Presse Méd. 62:289, 1954.

There is a great deal of discussion of the sphincter of the pancreatic duct and its hypothetical role in biliopancreatic disease. Little, however, has been known of this sphincter. The authors have made a thorough anatomic and radiologic study of the problem to determine the exact role of the sphincter in disease of the pancreas.

Anatomically, it is known that the common bile duct and the pancreatic duct traverse the muscular layer of the duodenum separately, before they unite. There are muscular fibers around the common duct and the distal portion of the two ducts after their union. But the problems still remain: Are the fibers that encircle the ducts independent of those of the duodenal wall? Are there circular muscle fibers around the terminal portion of the pancreatic duct? At what level is the pancreatic sphincter—if any—situated? What is its role in disease of the pancreas?

Detailed histologic studies of transverse and longitudinal sections of the distal 3 cm.

of the pancreatic duct have shown that there exist (a) important circular muscle fibers, constituting the sphincter of Oddi; (b) some longitudinal muscle fibers; (c) other minor circular fibers, and (d) elastic fibers about 2 cm. proximal to the sphincter.

Correlated radiologic studies have shown that, from the physiologic point of view, the true pancreatic sphincter is identical with the upper part of the sphincter of Oddi.

The authors conclude that the inconstant, incomplete circular muscle fibers of the pancreatic duct just proximal to its juncture with the common bile duct do not exercise any efficient sphincteric action. In a cholangiographic procedure the reflux into the pancreatic duct seems to depend more on the equilibrium of pressure between the pancreatic sphincter.

These experiments indicate that the sphincter of the pancreatic duct does not play any important role in pathologic conditions of the pancreas.

S. A. GUEUKDJIAN, M.D.

Plunging Ranula: A New Therapeutic Approach. Keen, P.; Cohen, L., and Shapiro, M. P.: South African M. J. 28:189, 1954.

The plunging ranula appears to be rather rare outside the South African Bantus. In the author's opinion these cysts are of branchiogenetic origin and usually occur in the floor of the mouth at birth. During childhood the cysts enlarge and escape from the mouth by way of the weak spot in the oral floor, along the posterior border of the mylohyoid muscle, and then fill the space of the anterior triangle of the neck. Although small retention cysts in the floor of the mouth are easily curable by surgical treatment, the lesions considered here are the deep plunging variety that require extensive dissection for their complete removal, with inevitable recurrence if the removal is incomplete.

The conventional treatments require extensive operation, and even this frequently meets with failure. The treatment recommended by the author is aspiration of the contents of the ranula, followed by injection of 2 cc. bisoxyl (a 10 per cent aqueous suspension of bismuth oxychloride) into the remaining cyst cavity. The bisoxyl is then dispersed throughout the cavity by massage, after which the patient is treated by roentgen therapy, 180 Kv., 0.5 mm. copper filter, 50 cm. F.S.D., H.V.L. equal to 1 mm. of copper, field size usually 10 by 8 cm., a single dose of 300 r being administered to the skin overlying the affected submaxillary region.

This method of treatment is based on the assumption that a plunging ranula is a single cyst, for it is essential that the bismuth particles should reach all the cells lining the cavity if the treatment is to be effective.

The technical difficulties encountered include loculation due to previous operation or infection, and poor dispersion of the bismuth particles due to the large size and irregularity of the cyst cavity.

In the experience of the author, ranulae have been found resistant to conventional radiotherapy and as tolerant of radiation therapy as normal skin. In order to achieve complete destruction of such tissue, therefore, one would require a necrosis-producing dose of radiation—not less than 4 times the threshold skin-erythema dose, or 3,000 r of conventional high voltage roentgen rays delivered at a single sitting.

The authors have arbitrarily chosen for the treatment of ranulae after the injection of heavy metals (300 r normal skin dose), generally delivered through a single field. The more distal and peripheral portions of the cyst usually intersect the 30 per cent to 40 per cent isodoses, thus probably receiving no more than about 100 r from the direct beam. Since the authors have had no failures, they assume that the bismuth increased the intensity of the local ionization not less than thirty times. Secondary radiation for roentgen-irradiated matter consists largely of electrons, which is the photo-electric effect. With secondary electrons, their intensity increased non-linearly, with increasing atomic numbers and wave lengths. Bismuth, which has the highest atomic number of all nonradioactive elements, has therefore been chosen by the authors.

The distance traveled by a photo-electron in tissue is determined by the wave length of the radiation and the atomic number of the absorbing material. It was calculated that the effective range of this photo-electron in tissue was about 6 microns, which is somewhat less than the thickness of a single cell. The lining of a typical ranula consists, at least in the case of the so-called plunging variety, of a single layer of cuboidal epithelial cells, and therefore it is eradicated by this method, which would not be effective in cysts with thicker walls.

The authors report no failures in 25 con-

secutive cases in a series observed over the past three years.

HENRY J. ROSEVEAR, M.D.

Menière's Disease. Successful Treatment by Minor Surgery. Rosen, S.: Lancet 1:133, 1954.

The ideal operation for Menière's disease is one that preserves the hearing and the static labyrinth. By simple section of the chorda tympani nerve, 82 per cent of a series of 50 patients obtained relief of the attacks. This operation should be performed on all not cured by medical treatment before even considering the destruction of the labyrinth and auditory nerve.

Two cases are reported of severe Menière's disease on the side of a dead labyrinth. The internal ear is therefore not the exclusive structure from which the vertigo syndrome arises. The chorda tympani is a mixed sensory nerve carrying touch, pain, taste and sonic-equilibratory functions. Stimulations can pass up this nerve to the vestibular and cochlea nuclei, completely bypassing the internal ear.

CLAUDE M. WARREN JR., M.D.

Exogenous Post-transfusional Hemochromatosis: An Anatomic Study (Hémochromatose exogène post-transfusionnelle. Etude anatomique). Bousser, J., and Pean, G.: Presse Méd. 62:296, 1954.

Since Kark's first observation (1937) of exogenous hemochromatosis following repeated blood transfusions, 25 cases have been reported, including the present contribution. Previous reports have lacked pathologic details. In this work the authors present a thorough study of 4 cases and arrive at conclusions from anatomopathologic observations.

In the first case a boy aged 17 had Fanconi's disease; he was given 143 transfusions (43.5 litres of blood). In the second a man aged 44, with Hodgkin's disease, was given 26 transfusions. In the third case a woman, 77 years old, with Kalher's disease, was treated with 20 transfusions, and the fourth, a man of 60, with the same disease, underwent 25 transfusions.

The main anatomopathologic features of exogenous hemochromatosis are stated: (a) visceral siderosis, (b) hepatosplenogandular sclerosis and (c) parenchymatous hepatitis. The condition is in some ways analogous to idiopathic pigmentary cirrhosis. Siderosis is diffuse and especially massive in the liver, glands, spleen, pancreas, thyroid, adrenals and myocardium, in that order. The pituitary, testicle, kidneys and lungs are only slightly siderotic, and the intestine and skin escape. Sclerosis is invariably associated with the disease, and in the liver it is primarily periportal. Sclerosis of the glands and spleen is also marked, but other organs are not so deeply affected. Intercurrent hepatitis, although not necessarily present, is a common complication.

The anatomic picture of exogenous hemochromatosis has many features parallel with those of idiopathic pigmentary cirrhosis, and these analogies are discussed in the light of histologic observations.

Excellent color photomicrographs and an international bibliography enrich this excellent study.

S. A. GUEUKDJIAN, M.D.

Intravenous Cholangiography: Its Status in the Radiologic Exploration of the Biliary Tract (La cholangiographie par voie veineuse. Sa place dans l'exploration radiologique des voies biliares). Seneque, J.; Le Canuet, R.; Debray, C.; Roux, M., and Aussage, J.: L. Presse Méd. 62:281, 1954.

A new product with a 64 per cent iodine content is tested for intravenous cholangiographic study. It is stated that this radiopaque medium is rapidly eliminated by the liver, thus giving a clear picture of the biliary tract. If liver function is deficient, the solution is eliminated by the kidney, which yields a pyelogram.

Biligrafin, as the solution is known, bypasses the portal circulation, for there is no enterohepatic cycle like that associated with cholecystographic examination by the oral route. It also does not depend on the integrity or even the presence of the gallbladder.

The authors have observed that it is well tolerated in spite of its high iodine content, and no case of iodism has been reported. One is advised, however, to take the usual precautions, and for patients with hepatic failure it may be better not to use this route.

The technics of administration and the radiographic details are discussed. It is advised to inject 8 Gm. (2 ampules of a 20 per cent solution) in six to eight minutes.

In ten minutes the hepatic and common ducts begin to be visualized. The gallblad-

der fills at about the fifteenth minute, and the shadow deepens progressively. Passage into the duodenum is very rapid. In twenty-four hours the whole of the contrast medium is in the colon. Pictures obtained with this substance are more extensive — not necessarily clearer — than those taken after use of products heretofore employed. The minutiae of interpretation of normal and abnormal cholangiograms are discussed, with good illustrations and sketches.

Intravenous cholangiographic study yields far more information on hepatobiliary disease than does the oral type and can be used even where the gallbladder has been removed or is excluded.

The intravenous route is recommended in all cases in which the oral route has given insufficient information and for all patients who have undergone cholecystectomy.

S. A. GUEUKDJIAN, M.D.

Some Observations Concerned with Carcinoma of the Breast: Part V. Miller, M. W., and Pendergrass, E. P.: Pennsylvania M. J. 57:421, 1954.

This report establishes statistically the penalties incurred by the patient when she ignores the symptoms of disease or delays in consulting her doctor after her discovery of a lesion. It is a reasonable inference that public education will reduce the tragic time interval in both instances. It is also probable that improvement in the survival rate may result from periodic self-examination of the breast rather than from accidental discovery by the patient herself of a local lesion in the breast.

EDMUND LISSACK, M.D.

Cholangio-Cholecystography: Its Pharmacology. Preliminary Observation on 100 cases (Cholangio-cholécystographie. Considérations préliminaires sur 100 observations — Action pharmacodynamique). Nemours-Auguste, S., and Barag, N.: Presse Méd. 62: 300, 1954.

Intravenous cholangiographic study presents different possibilities for assessing hepatic function and studying the biliary tract. According to Rosental, one-third of the liver must be intact before normal function is possible. If the liver is healthy, intravenous cholangiographic examination gives good visualization of the bile ducts. If there is hepatic insufficiency one of the following eventualities is possible: (a) nonvisibility of the hepatic ducts; (b) delayed visibility of the gallbladder; (c) nonvisibility of all the bile ducts, or (d) elimination of the contrast medium not by the liver but by the kidney, resulting in the need for a pyelogram.

Cases are recorded in which this procedure produced a diagnostic picture when the usual methods of examination had failed. The authors present interesting contrast pictures.

The mechanism of the bile ducts and the pharmacologic character of the contrast media were studied by different methods. Noting that 1 cc. of morphine accelerated the excretion of the opaque substance by the liver, the authors used it whenever the bile ducts were poorly visualized. This morphine reaction had never been recorded before this report of observations made on 100 cases. Inhalation of amyl nitrite helped to fill the common bile duct by relieving the painful spasm. Boyden's meal activated the evacuation of bile (and the opaque medium) both in patients whose gallbladders were normal and in patients who had undergone cholecystectomy or had excluded gallbladders.

This new intravenous cholangiographic medium, (N-adipino-di (3-amino-2, 4, 6, triiodo phenyl—sodium-carbonate) is claimed to have opened new possibilities in roentgen diagnosis of diseases of the bile ducts.

S. A. GUEUKDJIAN, M.D.

When a man has anything to tell in this world, the difficulty is not to make him tell it, but to prevent him from telling it too often.

—*Shaw*